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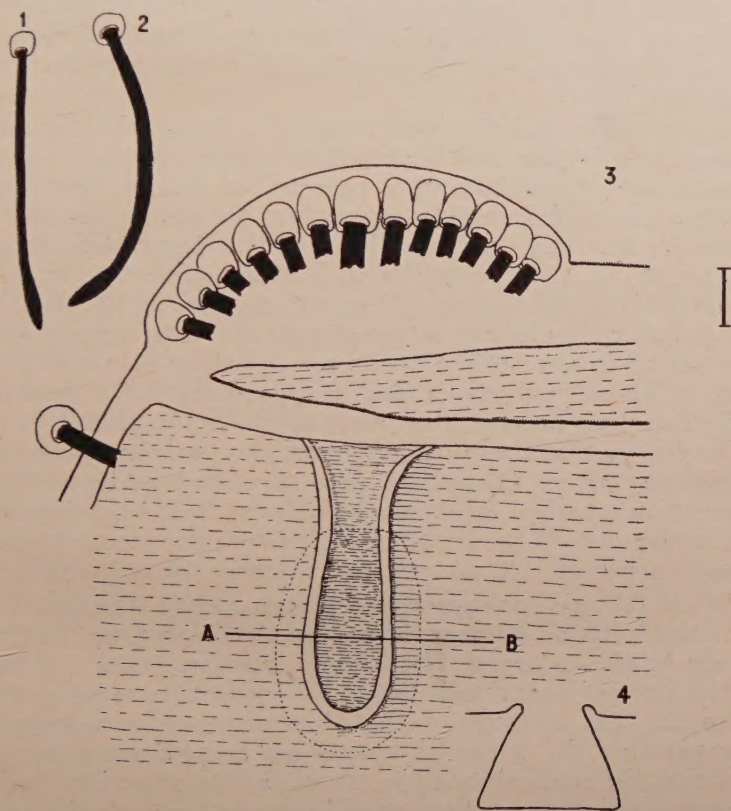
A NEW TYPE OF EXTERNAL ORGAN FOUND IN THE MALLOPHAGA.

BY THERESA CLAY, B.Sc.

British Museum (Natural History).

Two female specimens of a new genus and species of Mallophaga recently examined show an external cuticular organ of a type hitherto undescribed in the Mallophaga, or, as far as is known, in any other insect.

The species belongs to the subfamily MENOPONINAE and its affinities would seem to lie with those of *Menopon* Nitzsch *sens. str.* As only one sex of this species is known and as there is some doubt as to its true host¹ the genus and species will not be described until further material is available.



FIGS. 1-4.—(1) Single seta from pocket, $\times 500$; (2) central seta from pocket, $\times 500$; (3) part of terga 6 and 7 showing pocket and origin of setae. Line=0.008 mm.; (4) longitudinal section of pocket at level A-B in fig. 3.

¹ The specimens were taken from a skin of *Ptilinopus bellus* (Selater), a New Guinea pigeon; a large number of skins of many species of *Ptilinopus* have been searched in vain for further specimens. It is possible, therefore, that another New Guinea bird is the true host, contamination having taken place during collecting. Much confusion has already been caused in the systematics of the Mallophaga by the describing of new genera and species from one sex and with incorrect type hosts.

Each specimen shows a single pair of these organs on the dorsum of the abdomen. Each organ comprises a curved row of stout elongate setae arising immediately posterior to the sixth tergite; the setae are directed backwards and their apices, which are clubbed, are held in a pocket-like depression in the adjoining posterior tergite (fig. 3). The posterior margin of the sixth tergal plate is indented to allow for the curvature of the row and there is a strip of intertergital sclerotization between the sixth and seventh tergites. There are 11-13 of these setae, the most central one of each group being longer and stouter than the lateral setae (figs. 1 and 2). The apices of some of the setae of each organ are spirally twisted about each other within the pocket. Each seta appears to be a modified type of the normal setae found along the posterior margin of the tergites of this and other segments.

The pocket, lying in tergite 7, has a thickened rim round the dorsal opening, and its ventral base is nearly flat (figs. 3 and 4). Whether or not this base represents a direct opening of the pocket into the abdomen cannot be determined.

It is not possible, with the present material, to say what the function of the setae may be nor that of the whole organ. The specimens were dead and in a dried condition when collected, and it has therefore been impossible to determine whether or not there are glands associated with the pocket or the setae. I have discussed this organ with Dr. H. E. Hinton, Dr. W. H. Thorpe and Mr. J. F. Gates Clarke, to whom I am much indebted for the following suggestions. Dr. H. E. Hinton has pointed out that the clubbed setae are not very dissimilar in shape to the setae which in some other insects are known to be associated with the openings of odiferous glands, and he suggests that if it should prove to be the case that an odiferous gland opens in the pocket or on the apex of each seta, that the posterior pocket may function in one or both of the following ways: (1) to hold the setae close together so that any excess secretion is carried by capillarity between their adjoining surfaces, and the surface area of the liquid, and therefore its rate of evaporation thus greatly increased; (2) to serve as a reservoir for the secretion.

Dr. W. H. Thorpe has suggested a proprioceptive function for these organs. Pringle (1938 : 467) has shown that the hairs of the "hair plates" on the legs of the cockroach (*Periplaneta americana*) are excited by a fold of the intersegmental membrane, the excitation varying with the position of the joint, and suggests that these plates and similar structures in other parts of the bodies of insects act as proprioceptive organs. The fact that the setae involved in the organ described here appear to be modified types of the sensory setae normally found on the abdomen would make such a function possible. These organs may, therefore, have a proprioceptive function associated with some unusual movement of the abdomen, and in which the intertergital sclerotization may act as a hinge.

Mr. J. F. Gates Clarke has drawn my attention to a somewhat analogous condition found in some of the Microlepidoptera. In five species of *Stenoma* the males have a "hairpencil" arising from the basal part of the anal section of each hind wing; the end of each "hairpencil"

is held in a groove in the abdomen, which, depending on the species, passes over two to four segments. Meyrick (1930 : 29) refers to this condition in *S. vacans*. There is no indication of what the function may be of the "hairpencil" (formed, of course, from modified scales, not setae) in the *Stenoma* species.

Some knowledge of the biology of the species and whether these organs are also present in the male is essential before any suggestions can be made for the function of an odiferous secretion, if this proves to be associated with the organs; or if the organs prove to have a proprioceptive function, why such a function should be necessary in this particular part of the body.

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THE ECLOSION OF TSETSE (*GLOSSINA*) LARVAE (DIPTERA).

BY C. H. N. JACKSON, D.Sc., Ph.D.

(Department of Tsetse Research, Tanganyika.)

THESE observations were made on wild *Glossina swynnertoni* Austen. The sections were cut at a thickness of 10 microns and stained with Delafield's haematoxylin and eosin. Whole larvae were mounted in polyvinyl alcohol lacto-phenol.

The mouth in the first instar larva is antero-dorsal (Roubaud, 1909) and is blocked by a chitinated median tooth about 0.5 mm. long. This tooth is shown in Plate 1 (figs. 1 and 2) in an entire larva, and in transverse section in Plate 2 (fig. 3). It is cast with the skin of the first instar, and until then prevents attachment to the teat of the mother. The tooth appears to be movable in the dorso-ventral plane, and is evidently an egg-tooth, used to puncture the chorion, which then splits Plate 2 (fig. 4) along a line of weakness on the dorsal side as described by Newstead, Evans and Potts (1924). An oral egg-tooth in an insect is probably unique, because though egg-bursters are dorsal the mouth usually is not.

The removal of the chorion is then accomplished by a special organ arising from the floor of the uterus; this organ I have called the choriothete from *χορίον*, skin or shell, and *θετης*, one who places or disposes. At its anterior end the choriothete is attached to the floor of the uterus, but posteriorly it rises from the floor and projects freely backwards to a point below the nerve cords of the first instar larva and immediately above a depression in the floor. Posteriorly the choriothete is a hollow organ and throughout its length it is provided with a characteristic dorsal columnar epithelium which by some means not elucidated is able to adhere to the chorion and afterwards to release it. It is present in the freshly emerged fly, where it was seen by Stuhlmann (1907, Plate 4 (fig. 145), who refers to it in the text (page 61) as dorsal: "It is peculiar that this fly had on the dorsal side of the uterus a strong thickening of the epithelium, whose significance is obscure to me." Several of his figures, however, Plate 2 (figs. 55 and 56), Plate 4 (figs. 138 to 141) are reproduced upside-down. Plate 3 (fig. 5) shows the choriothete removing the chorion from the anterior end of a hatching larva, which has shrunk in fixation. The choriothete is here attached to the floor of the uterus by a muscular apparatus which enables it to change its shape, and probably, as Dr. P. Tate has suggested to me, to force blood into its posterior cavity. Plate 3 (fig. 6) shows the posterior part of the choriothete in the same specimen, where it is lying free of the uterus floor. In both of these figures the dorsal epithelium can be seen gripping the chorion closely and apparently drawing it downwards away from the larva. Plate 4 (fig. 7) illustrates the same process, but with a larva which is not shrunken, showing that it is the activity of the

choriothete and not of the larva that causes the downward movement of the chorion, which is slightly separated from the larva, but closely adherent to the choriothete.

The chorion becomes tightly folded, presumably by being drawn into the folds of the choriothete shown in Plate 3 (figs. 5 and 6); and this organ then apparently passes the folded chorion posteriorly until it descends into the depression in the uterus floor. Plate 4 (fig. 8) shows a section through the anterior part of the choriothete below a late first instar larva, where it is still attached to the floor of the uterus and the chorion has already passed backwards out of sight. Plate 5 (fig. 9), farther back in the same specimen, shows the chorion being carried backwards along the dorsal side of the freely projecting portion of the choriothete; and fig. 10 shows the extreme posterior tip of the choriothete, with the folded chorion descending into the depression in the uterus floor. Finally, Plate 6 (fig. 11) shows the folded chorion lying in this depression below an early second instar (moulting) larva.

The choriothete grips the chorion from an early stage in embryonic development, when the primary germ bands are being formed. This is illustrated in Plate 6 (fig. 12) and Plate 7 (fig. 13), the first cut through the point where the choriothete is leaving the floor of the uterus, and the second where it is lying quite free. In both of these the embryo is somewhat shrunken. Presumably the choriothete does not begin to pull on the chorion until this is ruptured by the egg-tooth, when perhaps the choriothete receives a chemical stimulus.

The choriothete appears to remove the cast skins of the moulting larva also, and these come to rest in the same depression in the uterus floor. Plate 7 (fig. 14) shows the choriothete apparently seizing the first instar skin of a moulting larva. Here the larva is on the right of the photograph and the choriothete epithelium on the left; the larval skin is very delicate and transparent, but its minute spines can just be made out. Finally, Plate 8 (fig. 15) is of a section through the depression in the floor of the uterus below a late third instar larva. The skin of the larva (which later forms the puparium) can be seen at the top, and immediately below it is part of the skin of the second instar larva, the long bristles coming from between the posterior respiratory lobes. Below this is the chorion, with larval skins set with minute spines above and below it, and at the bottom can be seen the epithelium of the choriothete with the tightly stretched wall of the uterus just beneath. The choriothete at this stage, and in the late second instar, becomes forced backwards along the floor of the depression in the uterus, possibly by collapse of its cavity and pressure of the growing larva from above.

SUMMARY

The larva of *Glossina* bursts the chorion by means of an oral egg-tooth, and apparently the chorion is then removed, folded, and stowed in a depression in the floor of the uterus, by a special organ called the choriothete, which afterwards deals in the same way with the cast skins of the larva.

ACKNOWLEDGMENTS

I am greatly indebted to Mr. A. T. Culwick, of the Human Trypanosomiasis Research Station, Tinde, Tanganyika, and to Mr. J. W. Michieli, of the Wellcome Foundation, London, who took the photographs, and to Dr. V. B. Wigglesworth, F.R.S., of Cambridge, who allowed me to cut additional sections in his laboratory. I am also very grateful to him and to Professor D. Keilin and Dr. Tate of the Molteno Institute, Cambridge, for sparing time to look at my sections, though it must not be supposed that they necessarily agree with my interpretation of them; in particular, there is great difficulty in understanding how the choriotele can first seize the chorion and afterwards release it.

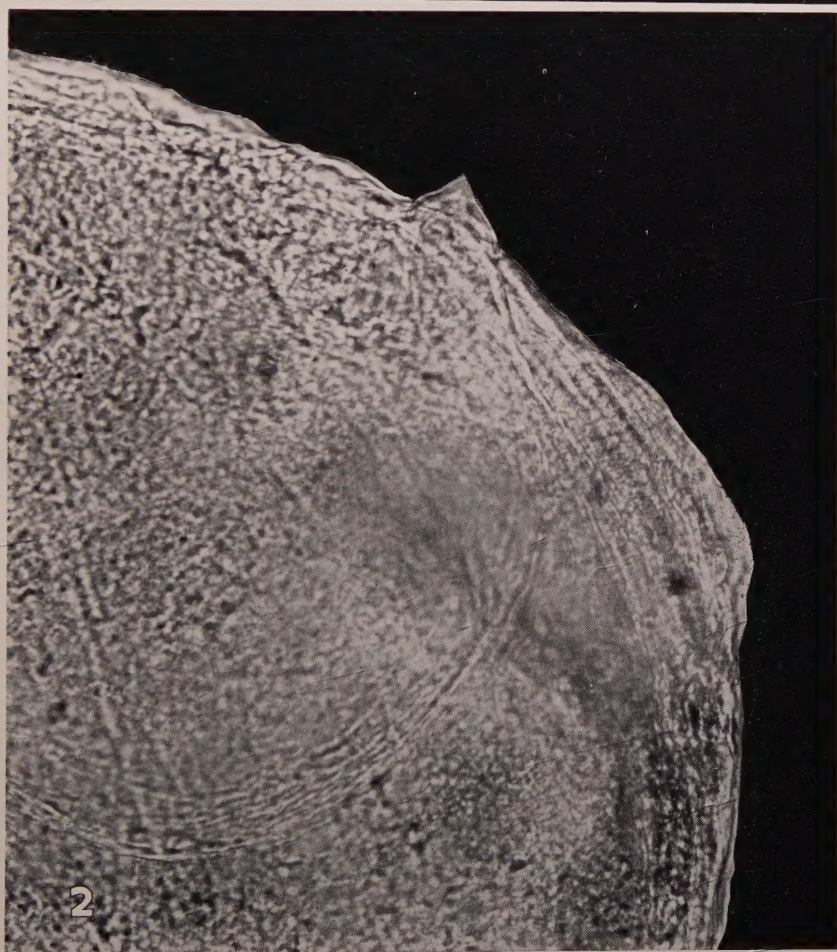
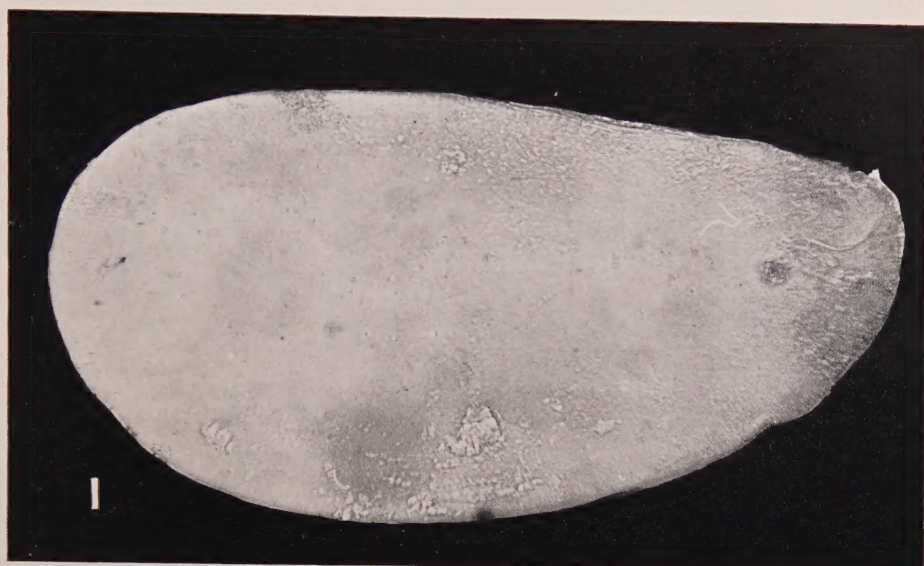
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PLATE 1.

FIG. 1.—Fly no. 1. Early first instar larva from right side, showing egg-tooth. $\times 80$.
Photo : J. W. Michieli.

FIG. 2.—Fly no. 1. Egg-tooth. $\times 650$. Photo : J. W. Michieli.



C. H. N. Jackson.

Eclosion of Tsetse larvae.

PLATE 2.

FIG. 3.—Fly no. 2. Egg-tooth blocking mouth $\times 780$. Photo : A. T. Culwick.

FIG. 4.—Fly no. 1. Chorion with dorsal split. $\times 70$. Photo : J. W. Michieli.

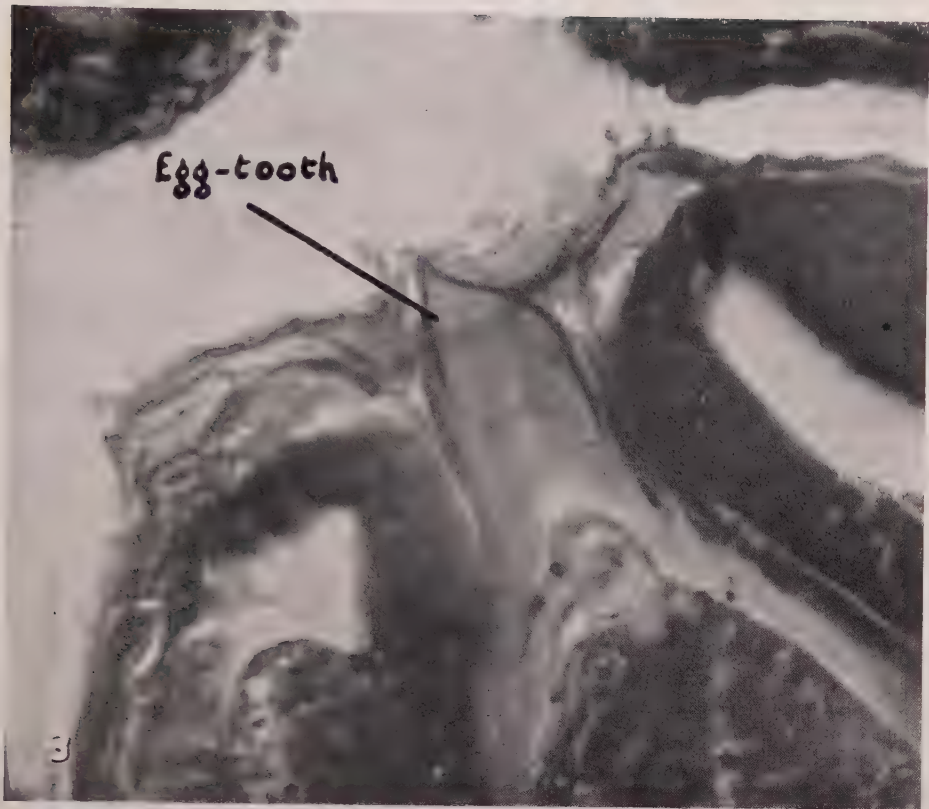


PLATE 3.

FIG. 5.—Fly no. 3. Larva hatching. Anterior end of choriothete, attached to floor of uterus. $\times 200$. Photo : J. W. Michieli.

FIG. 6.—Fly no. 3. Larva hatching. Middle part of choriothete, free of floor of uterus. $\times 200$. Photo : J. W. Michieli.

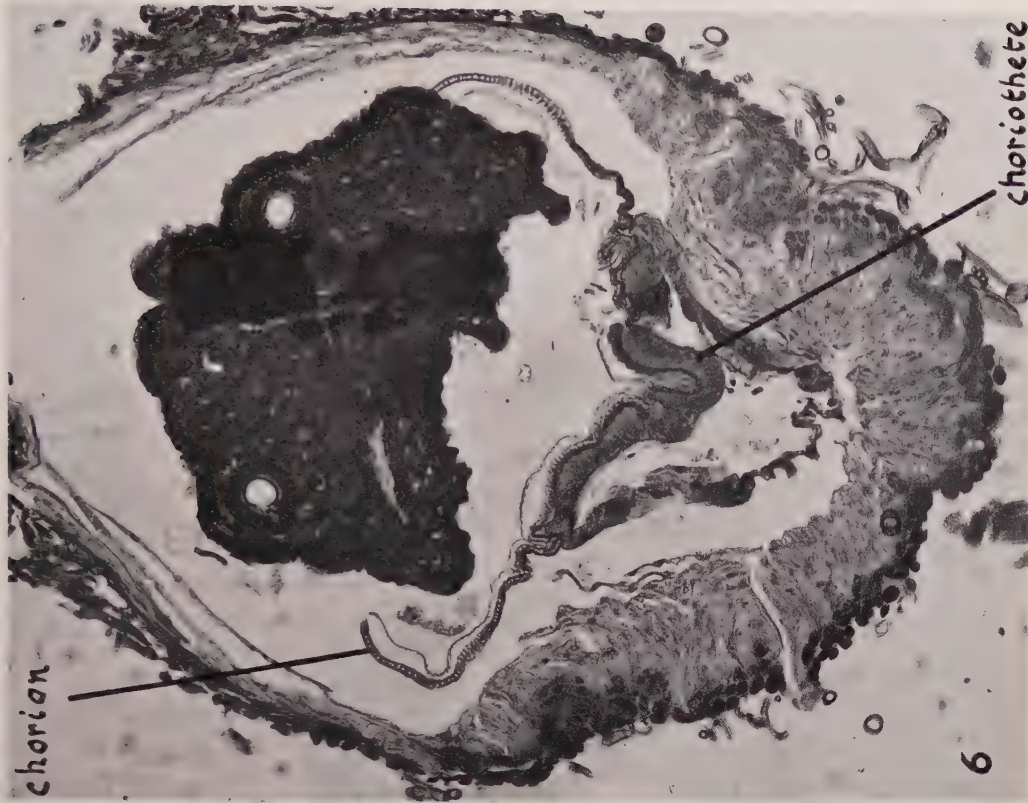
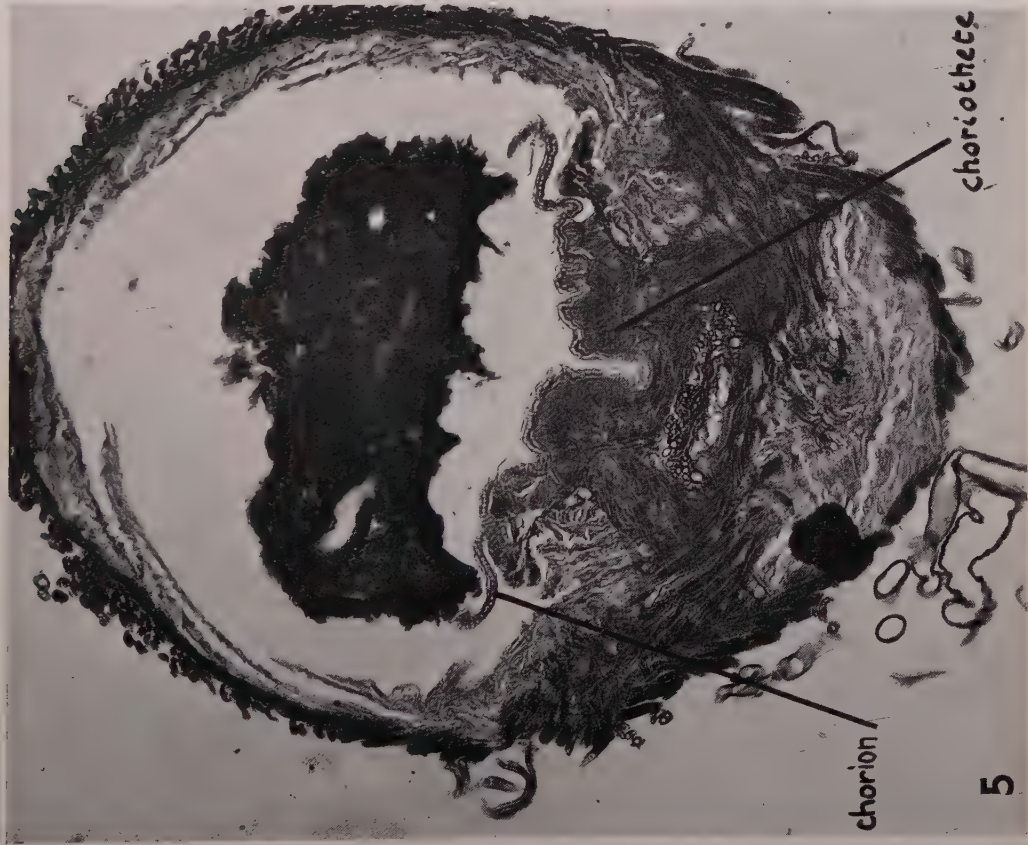


PLATE 4.

FIG. 7.—Fly no. 4. Larva hatching. Anterior part of choriothete. Larva not shrunk as in fly no. 3. $\times 200$. Photo : J. W. Michieli.

FIG. 8.—Fly no. 2. Late first instar. Anterior end of choriothete, attached to floor ; chorion has passed backwards out of sight. $\times 200$. Photo : J. W. Michieli.

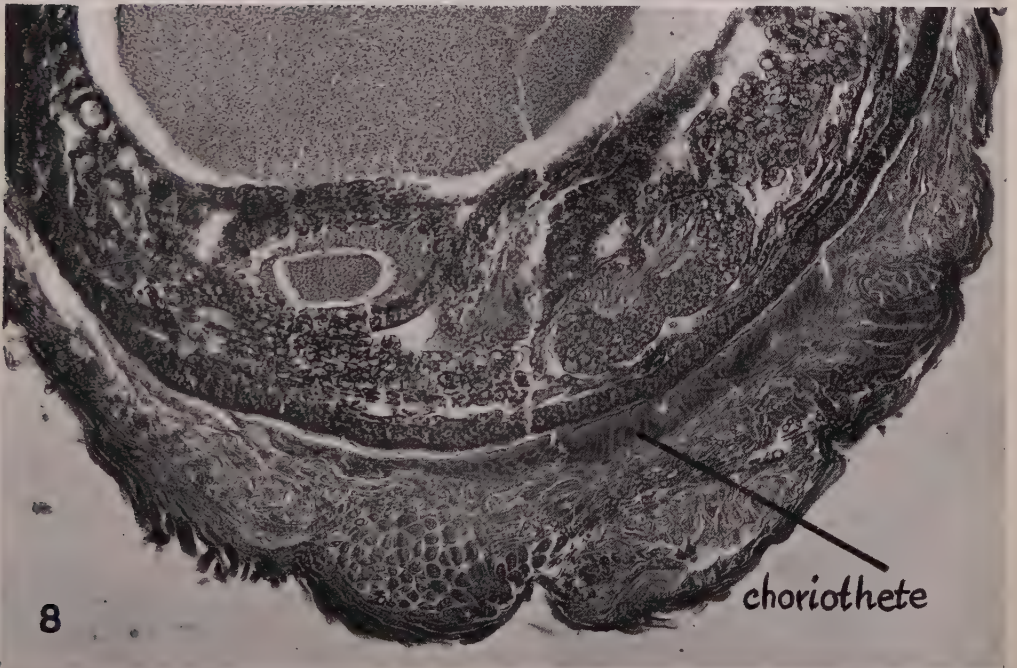
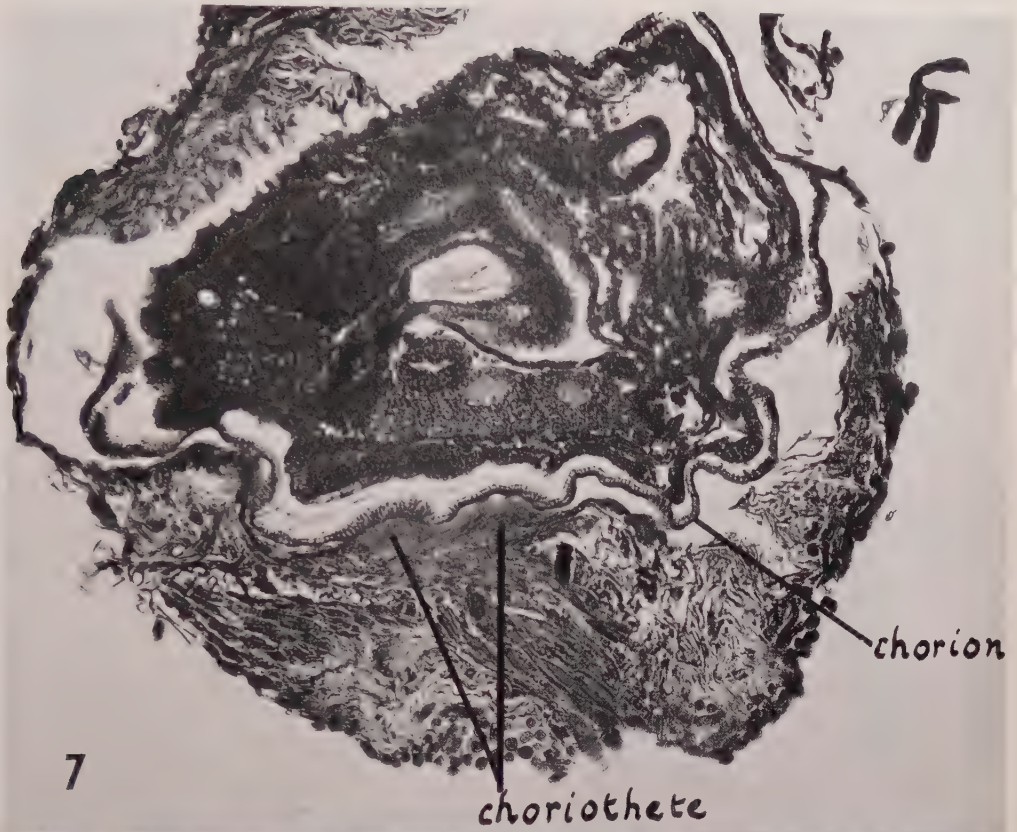


PLATE 5.

FIG. 9.—Fly no. 2. Middle part of choriothete, free of floor, with chorion passing backwards.
× 200. Photo : J. W. Michieli.

FIG. 10. —Fly no. 2. Extreme hind tip of choriothete, with chorion descending folded into
depression in floor. × 200. Photo : J. W. Michieli.

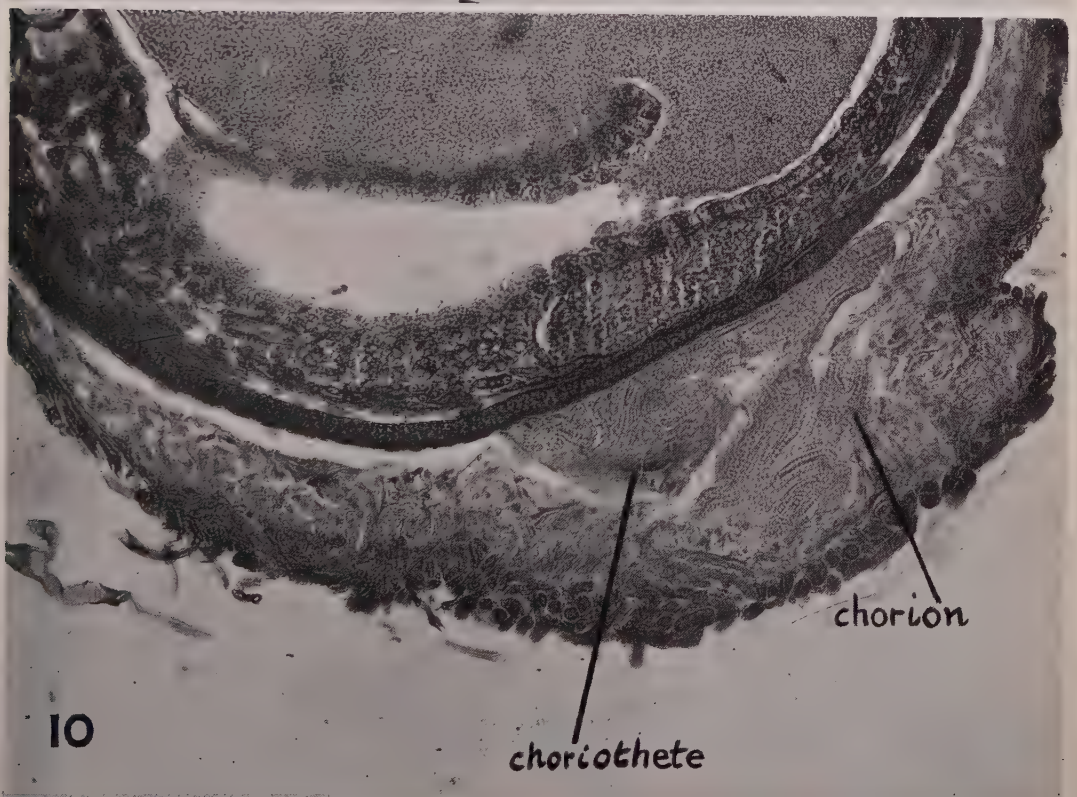
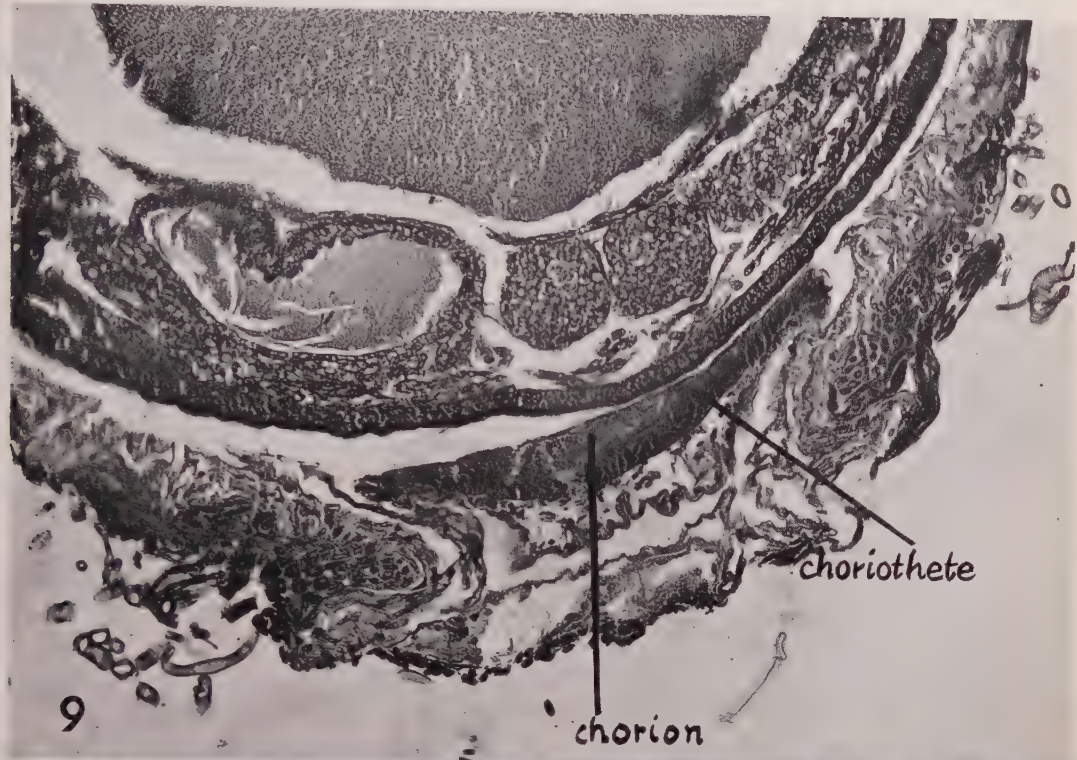


PLATE 6.

FIG. 11.—Fly no. 5. Early second instar, moulting. Folded chorion in depression in uterus floor, in region of proventriculus. $\times 200$. Photo : J. W. Michieli.

FIG. 12.—Fly no. 6. Embryo and middle part of choriothete, coming free of floor. $\times 200$. Photo : J. W. Michieli.

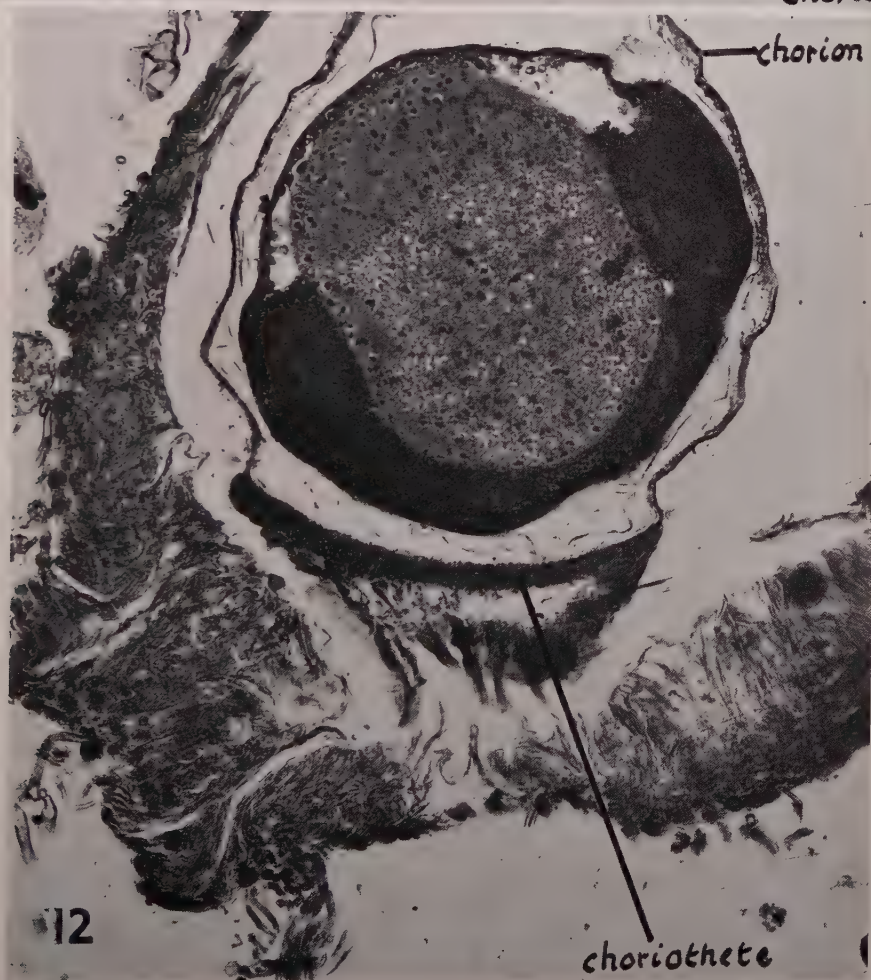
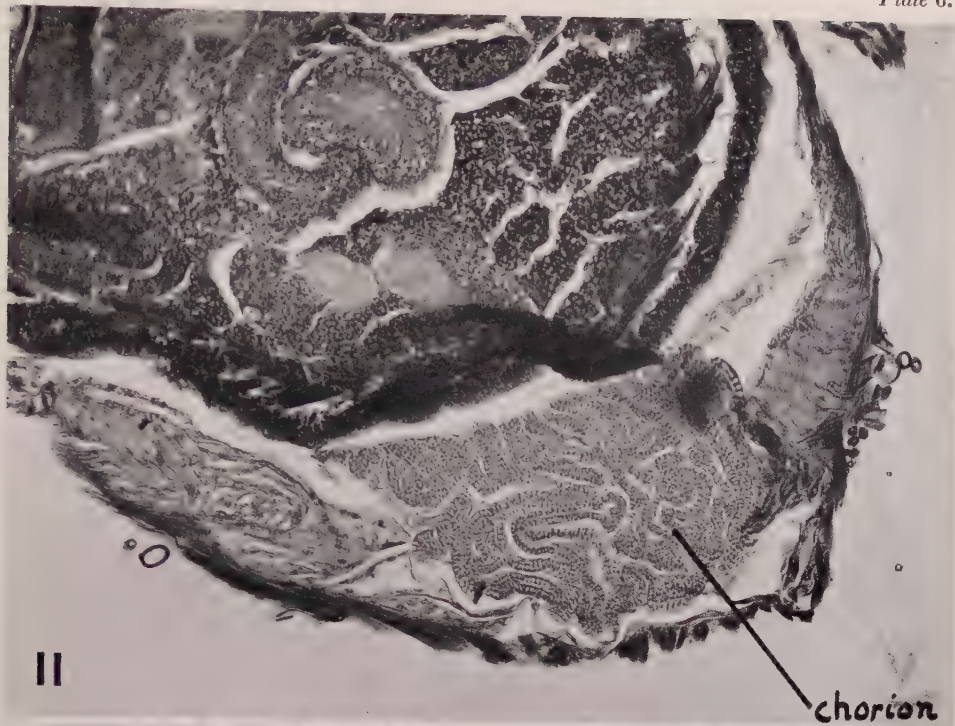


PLATE 7.

FIG. 13.—Fly no. 6. Embryo and hind part of choriothete, free of floor. $\times 200$. Photo : J. W. Michieli.

FIG. 14.—Fly no. 5. Early second instar, moulting. Choriothete (left) attached to uterus, removing first instar skin. $\times 700$. Photo : A. T. Culwick.

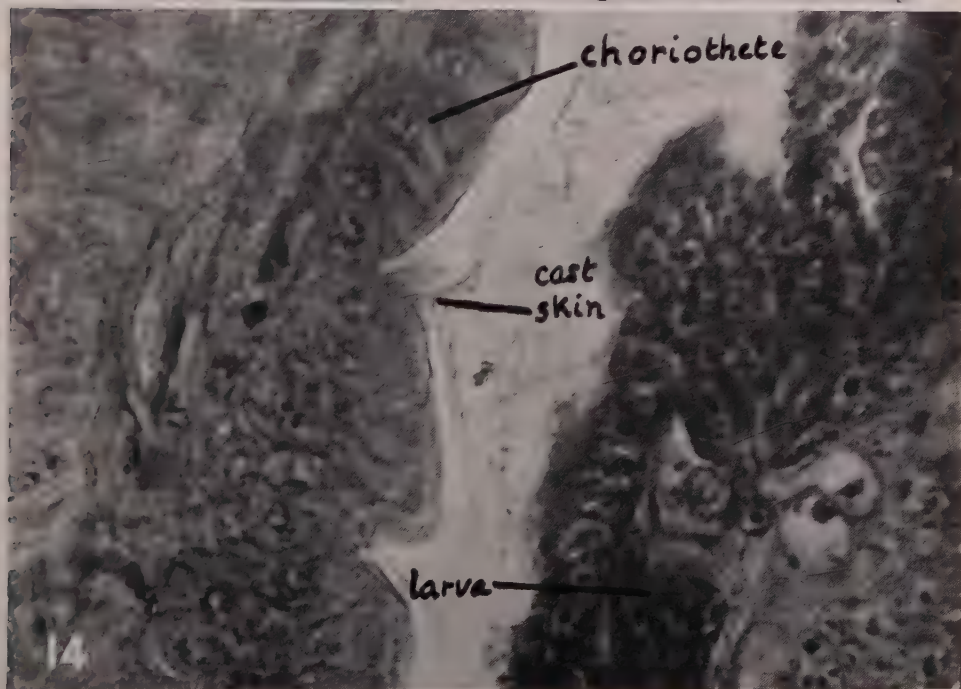
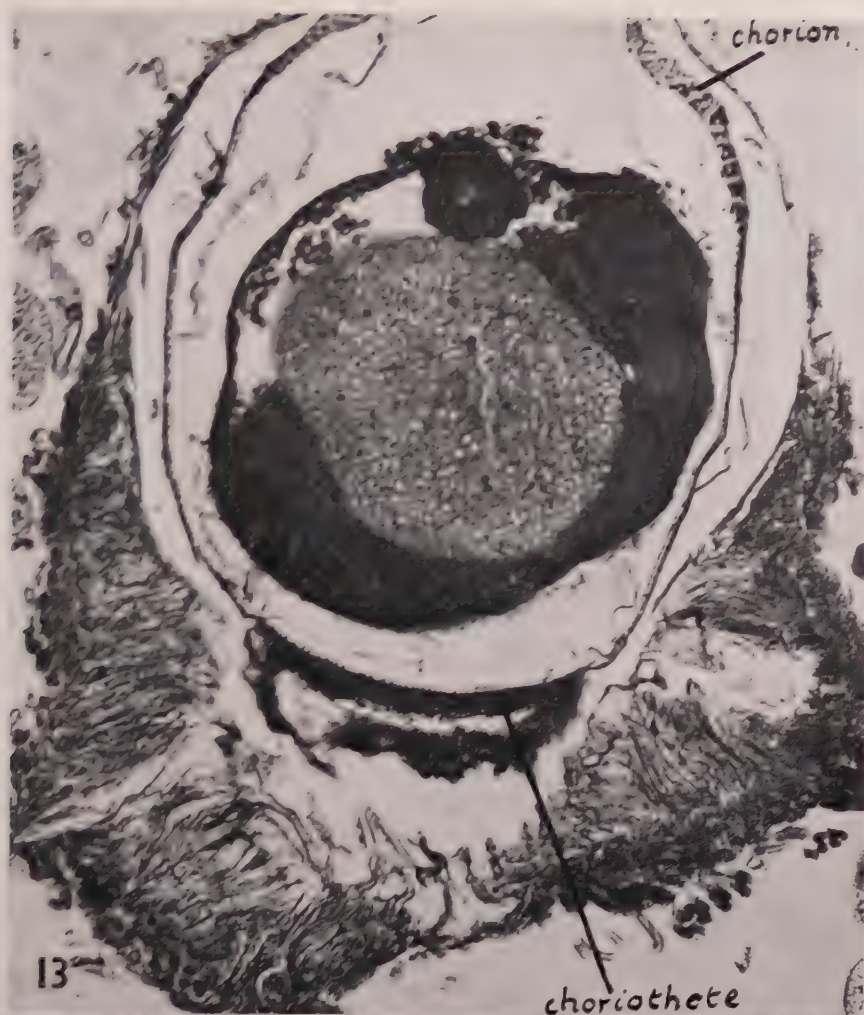
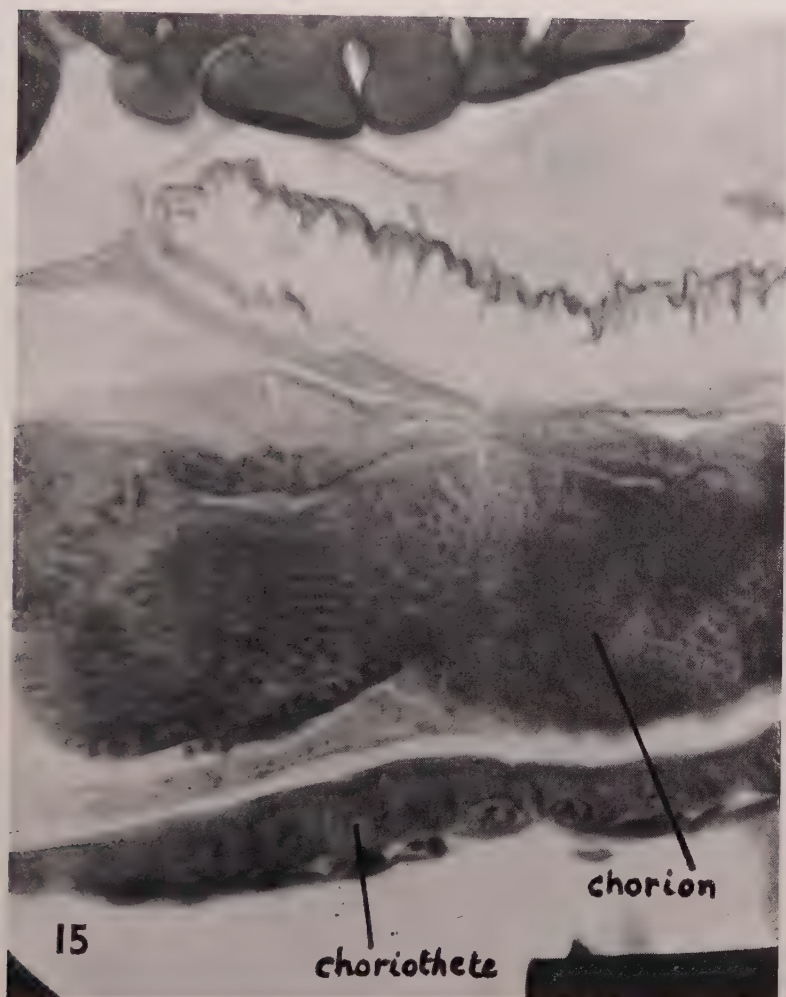


PLATE 8.

FIG. 15.—Fly no. 7. Late third instar. Chorion and first and second instar skins in depression in floor of uterus, between skin of third instar larva above and choriothete below. $\times 780$. Photo : A. T. Culwick.



C. H. N. Jackson.

Eclosion of Tsetse larvae.

NOTES ON *HARPAGOMYIA GENUROSTRIS* LEICESTER (DIPT. CULICIDAE).

BY M. O. T. IYENGAR, D.Sc.

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AND

M. A. U. MENON, B.A.

(Public Health Laboratory, Trivandrum)

Harpagomyia genurostris (Leicester) has a wide distribution in parts of India having heavy rainfall.¹ It is fairly common in Bengal and in Travancore, where the authors have made extensive collections. As far as is known at present this species breeds exclusively in collections of rain water at the leaf bases of certain plants, such as *Colocasia esculentum* (L.) Schott. and *Alocasia indica* (Roxb.) Schott. (ARACEAE), and the pineapple plant, *Ananas comosus* (L.) Merr. (BROMELIACEAE). The most common and prolific breeding places of this mosquito are water collections at the leaf bases of *Alocasia indica*, a cultivated plant with large leaves and spacious leaf bases. The breeding season is during the rains.

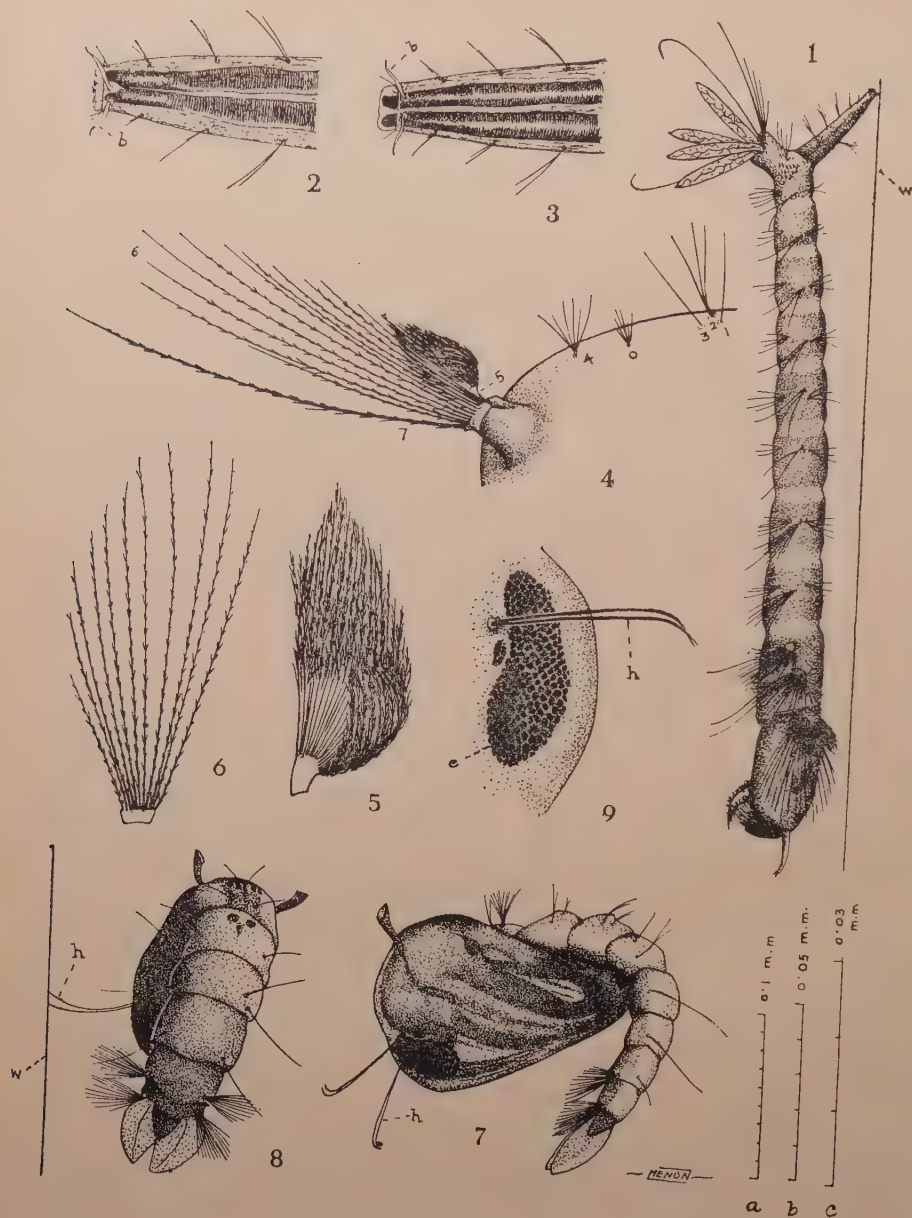
Certain peculiarities observed in *H. genurostris* are described in this short article.

The larva of *H. genurostris* generally stays submerged in water, coming up to the surface only occasionally. It is capable of withstanding prolonged submersion. When submerged, the larva either sticks to the sides of the container or lies at the bottom. The posture assumed by the submerged larva could be observed with some difficulty in the natural breeding places. It was easier for purposes of study to observe larvae kept in glass jars where they behave exactly as in their natural breeding places.

When the larva sticks to the side of the container it hangs vertically with its head downwards and with its dorsum towards the wall of the container (fig. 1 (1)). By tilting the jar, it will be observed that the point of attachment is at the tip of the siphon. On the dorsal aspect of the siphon close to its apex are two short bristles which are hooked at tip (fig. 1 (2 and 3)). These bristles serve to anchor the larva to the wall of the container.

When the larva is at the bottom of the container it does not browse in the manner of other Culicine larvae. Usually it lies supine at the bottom, the body fully stretched out and the mouth directed upwards and forwards. It feeds in this posture. The larva in this position rests on three points, posteriorly the apex of the siphon, and anteriorly the right and left lateral groups of hairs on the dorsum of the prothorax, which act as props for the thorax when the larva lies at the bottom. Each

¹ According to Barraud (1934), this species has been recorded from Assam (Golaghat), Bengal (Calcutta and Chittagong Hill Tracts), Bihar (Pusa), United Provinces (Dehra Dun) and Ceylon (Colombo). It has since been recorded from Travancore (Iyengar, 1938).



lateral hair group consists of three hairs (Hairs Nos. 5, 6 and 7 of the prothorax²) which arise together from a well-developed tubercle. The innermost of the group (Hair No. 5) is a short, dense and somewhat stiff tuft resembling a paint-brush (fig. 1 (5)). Its branches are feathered distally. Hair No. 6 (fig. 1 (6)) is fan-like with 12 to 18 long and finely

² The hairs are numbered according to the notation employed by Martini (1931 : 74).

feathered branches arising in a row from a flattened base. Hair No. 7 is single, finely feathered and longer than the largest branch of Hair No. 6. The tubercle bearing these hairs is capable of being partially erected by means of a muscle strand. When the larva lies at the bottom of the container, the thorax is propped up by these hair-tufts and thus the head is raised well above the floor of the container. Forward creep movement due to continuous action of the mouth-brushes is prevented by the anchoring effect of the hooked bristles situated at the apex of the siphon.

An interesting adaptation has been observed in the siphon of the larva. The two tracheae terminating at the apex of the siphon tube are capable of being protruded beyond the chitinised part of the siphon or retracted within it. This movement is controlled by a pair of muscle strands attached posteriorly to the ventral side of the tracheae and anteriorly to the lateral walls of abdominal segment VIII. When the muscle strands contract, the tracheal ends are retracted into the siphon tube. When they relax, the tracheae protrude beyond the apex of the siphon. In the submerged larva, the tracheae are in a retracted state, whereas in the larva floating at the water surface, the tracheae are exerted. The relative positions of the tracheae in the two conditions are shown in fig. 1 (2 and 3). This adaptation appears to be for the purpose of closing the spiracular opening when the larva is submerged and makes up for the absence of spiracular valves in this species. When the tracheae are withdrawn into the siphon, the spiracular opening is closed by the pressure of the membranous cap at the apex of the siphon. A highly transparent membrane is attached all round the rim of the siphon and which appears to be continuous with the lining of the two tracheae. When the tracheae are drawn in, the outer part of the membrane is seen as a circular flap at the tip of the siphon (fig. 1 (2)). Since the spiracular valves seen in other Culicine larvae are absent in *H. genurostris*, the chitinous lever ("Hebel" of Martini, 1931) which operates the valves is also absent.

The pupa of *H. genurostris*, like the larva, has a tendency to stay submerged for long periods. As the pupa, being lighter than water, would normally rise to the water surface, some means is necessary for the pupa to stay submerged. This is provided by a long, deeply bifid hair

FIG. 1.—*Harpagomyia genurostris* (Leicester).

- (1) A submerged larva hanging vertically from point of attachment to the wall (*w*) of the container. Side view. $\times 20$.
- (2) Distal part of the larval siphon showing the paired hooked bristles (*b*) at apex of the siphon, and the tracheae retracted into the siphon as observed in the submerged larva. Scale *b*.
- (3) Distal part of the larval siphon showing the tracheae exerted as observed in larvae floating at the surface. Scale *b*.
- (4) The dorsal prothoracic hairs (Nos. 0 to 7) of the left side of the larva. Hairs Nos. 5, 6 and 7 arise together on a well-developed tubercle. Scale *b*.
- (5) Brush-like hair-tuft (Hair No. 5) of the prothorax. Scale *c*.
- (6) Fan-like hair-tuft (Hair No. 6) of the prothorax. Scale *b*.
- (7) Lateral view of pupa of *H. genurostris* showing anchoring hairs (*h*). $\times 20$.
- (8) A submerged pupa (viewed from behind) anchored to the wall of the container by means of the anchoring hairs (*h*) of the left side. $\times 20$.
- (9) Anchoring hair of the pupa, right side, showing its point of origin. Scale *a*. *e*, imaginal eye; *h*, anchoring hair.

on either side of the cephalothorax arising from a point close to the anterior ventral margin just behind the imaginal eye (fig. 1 (9)). These hairs serve to anchor the pupa to objects below the water surface. The pupa could frequently be observed moored to the sides of the container by means of these hairs (fig. 1 (8)).



FIG. 2.—Lateral view of adult *H. genurostris* resting on a vertical surface.

The attitude of the adult *H. genurostris* when at rest is shown in fig. 2. The proboscis in the resting mosquito is bent under the body, much in the manner of the proboscis in the Hemiptera. The base of the proboscis is slightly swollen and forms a joint for the backward flexion of the proboscis. There is a further joint at the apical third of the proboscis and the part beyond this joint is swollen, hairy and very often slightly bent downwards.

Another interesting feature of the adult *H. genurostris* is the peculiar side-to-side rhythmic movement of the body in the resting mosquito. This movement is characteristic of this species. The mosquito rests on its fore and mid legs while the hind legs are lifted up and either curve over the body or extend out laterally. The fore legs at the points of contact with the resting surface are about 4 mm. apart, and the tips of the mid legs are 2 mm. apart. From these four points of contact with the resting surface, the body of the mosquito moves from side to side. The range of lateral movement of the body is as much as 4 to 5 mm.

There is no up and down movement nor any circular movement as observed in certain Tipulids. The body maintains the same level in respect to the resting surface and moves from side to side in a steady rhythmic manner. The significance of this movement is not known.

This movement is present during daytime and absent at night. It is feeble during the morning hours and at dusk. It is vigorous from 9 a.m. to 5 p.m., when the frequency is about 120 per minute. The frequency as well as the range of movement are greater when the insect is excited and when the insect alights after a flight.

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A NEW INTERPRETATION OF THE COURSE OF THE SUBCOSTAL VEIN IN THE WINGS OF ODONATA, WITH REMARKS ON ZALESSKY'S NOTATION

BY LT.-COL. F. C. FRASER, I.M.S., RETD., F.R.E.S.

IN these *Proceedings Series A* 19 : 37, (June, 1944), Mr. George Zalessky published a paper giving his reasons for making some changes in the terminology of insect venation. In a brief summary at the end of this paper, he stated that it was not concerned with the practical application of a new venational nomenclature or with the homologising of veins in connection with the use of the former ; it was, in fact, a mere apologia for the reasons which had induced him to make the changes. He introduced two new terms—"antemediana" and "antecubitus"—and his reasons for introducing these, stated briefly, were that he found certain of the main veins, when compared in the wings of fairly distant groups, altered their character as established by the terminology based on Lameere's theory, a convex one becoming concave and vice versa. Puzzled and dissatisfied by these seeming contradictions and inconsistencies, Zalessky has taken the facile and unusual method of adopting a notation of his own, which is apparently a return to the archaic meaningless systems which held sway among the fathers of entomology. For the new terms "antemediana" and "antecubitus" are meaningless since they neither indicate the origins of the veins nor their relationships to the others. It appears to me that Zalessky's difficulties have arisen through taking Martynov's obviously incorrect interpretation of the wing venation in *Euthygramma parallelum* at its face value, and because of other difficulties which he has met with from time to time in the interpretation of venation or his inability to appreciate the interpretations of others. These seem poor grounds to condemn Lameere's theory as both unworkable and fallacious.

Lameere's theory of alternating convex and concave veins, which, put simply, means a "pleated wing," is, I believe, applicable to all the wings of insects, although admittedly difficult in some and in the simply-veined wings of the Diptera in particular. For its application a good knowledge of the comparative anatomy of veins is necessary as also the recognition of certain principles involved—

1. When, in the course of evolution, a wing broadens, extra pleats are added by the addition of branches to the existing main veins or their branches : these begin by the interposition of simple "intercalaries" which latter originate usually at the periphery of the wing, gradually extend inwards and finally link up with already existing veins, then coming to be regarded as branches of the veins to which they have become attached, although rather incorrectly so. A vein once it acquires a junction with another is usually constant in that attachment, but there are numerous instances where a vein with its ending poised in the angle between two others may swing from one to the other : the latter is then said to have *captured* it. I have demonstrated this in the case of the LESTIDAE (*Proc. R. ent. Soc. Lond. (B)* 13 : 59, fig. 1), and I am of opinion that another such instance is to be found in the wing-venation

of *Euthygramma parallelum*, where Rii has switched from Rs to R (fig. 2, *di*).

2. When a wing narrows, the opposite occurs to what takes place in the broadening wing, that is, one or more pleats are lost and with each, two veins, a convex and a concave one, become obsolete. This is essential for the stability of the wing, for were it otherwise two veins of a like character, that is two convex or two concave ones, would be left in juxtaposition and the orderly rhythm of the alternations upset. Such a wing would be considerably weakened just as would a sheet of corrugated iron if you beat out one or more of its corrugations. But this loss of a pleat is not an abrupt affair: probably a vast span of time is taken in its completion, during which the two veins gradually close in on one another, pressing out the pleat and included vein between them until they atrophy and disappear. When two veins of like character are seen in a fossil wing running closely parallel, it may mean one of two things: either the wing folded at this level when closed, the two veins acting as a hinge, or else an included vein of an opposite character has been lost at this level. The wing of *E. parallelum* is so narrow that I do not think the first of these is the explanation of the apposed veins. There are many such instances as this found in the wings of insects, and generally it is not difficult to tell which vein has been lost. In the present wing, this vein is, I think, CuA, and the veins bordering it MP and CuP. Martynov went wrong, as others have done before him, by starting to name the veins in rotation from the costa posteriorwards without regard to their character, whether convex or concave, and without taking into account the possibility of any of the veins being absent. Lameere never stipulated that the whole of the veins should be present in any wing; all he maintained was that convex and concave veins must alternate in the fully fashioned wing. In fig. 2, *d.i* to *iv*, I have shown what I consider to be the probable interpretation of the venation of this species: in it Rii has switched its former attachment from Rs to R, whilst Rs has fused with MA; this latter and the loss of CuA parallel the evolution which has taken place in the Odonata, but the venation differs from that Order in that MP is still preserved. In its present condition, MP and CuP stand so close together that they function as a single concave vein which circumstance preserves the wing from any serious weakening: a study of the cross-sections, particularly that depicting the fossil as it stands, serves to show that there is little or no loss of the alternation of convex and concave veins (fig. 2, *d.ii* to *iv*). Ultimately MP would have been lost too.

Another of Mr. Zalesky's difficulties is that he finds individual veins changing their character, thus a convex vein may become a concave one in another part of the wing and vice versa. He cites an example of this which he appears to think is confined to the wings of members of the genus *Aeshna* (Odonata), whereas it is common to the whole of the Order! This is the case of the Costa, which is a convex vein as far as the nodus and becomes a concave one distal to that level. Zalesky makes this significant remark about the morphology of this area of the wing, although its importance appears to have escaped him: "It is true that in this case, a free concave subcosta extends to the nodus, disappearing farther on and seeming to take part together with the costa

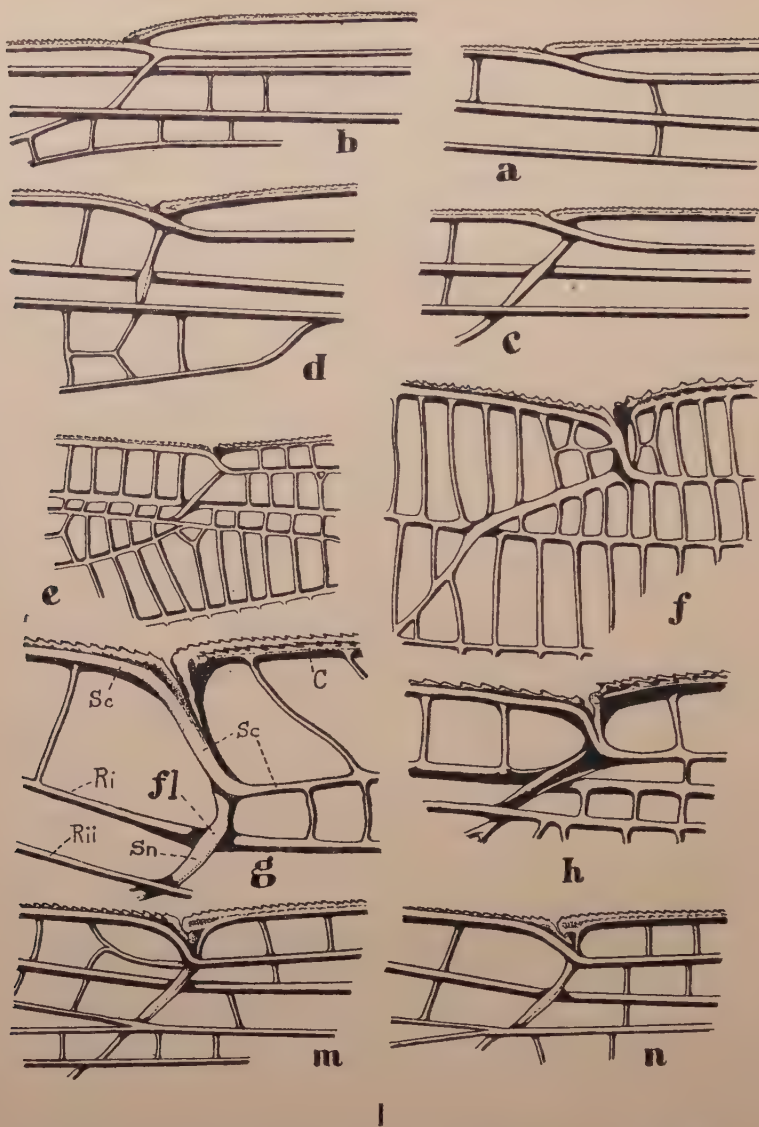


FIG. 1.—Nodus from beneath showing course of subcostal vein in—*a*, *Kennedyia mirabilis* Tillyard (Lower Permian)—Note how the subcostal vein overruns the costa and replaces it after the level of the nodus; note also the absence of the subnodal brace; *b*, *Permagrion falklandicum* Tillyard (Upper Permian)—Note downward curve of costa to meet subcosta and that, otherwise, the condition hardly differs from present-day Coenagrions; *c*, *Coenagrion dyeri* Fraser (recent)—Compare with last figure; *d*, *Thaumato-neura inopinata* McLachlan (MEGAPODAGRIONIDAE); *e*, *Agrion atrata* (Selys) (AGRIONIDAE); *f*, *Polythore victoria* (McLachlan) (POLYTHORIDAE)—Note the high state of organisation of the nodus reached in this species and the bayonet-like curve of the subcostal vein; *g*, *Camacinia gigantea* (Brauer) (LIBELLULIDAE); *h*, *Epallage fatima* (Charpentier) (EPALLAGIDAE); *m* and *n*, *Aeschnophlebia longistigma* Selys (AESHINIDAE), fore- and hind-wings—Note in the fore-wing a false extension of the subcosta and compare with fig. *f*, which shows the earlier stage of this formation. *Sn*, Subnodus; *fl*, fulcrum of subnodus.

in the formation of the costal margin." This is of particular interest to me as I have made a close study of the area of the nodus in the dragonfly wing and over a long time have examined the nodus in practically every genus of the Order: I have on more than one occasion discussed with Mr. J. E. H. Roberts the possibility of a different course for the subcostal vein from that which it is at present thought to run—viz., from the base of the wing to as far only as the nodus.

In the Palaeodictyoptera and Protodonata, believed to be the ancestors of the Odonata, the subcostal vein is seen to run in close relation to the costa to as far as the apex of the wing, at which point it finally merges with that vein. But even at that early date there is evidence to show that the subcostal vein was either shortening or forming a junction with the costa at a point decidedly more proximal. In the earliest known true Odonata, the Protozygoptera and Protanisoptera from the Lower Permian, the vein is seen to terminate at the level of the nodus, and it has remained more or less static at that point right up to the present day. In the most modern genera there seems to be a tendency for the nodus to shift distalwards and with it, the apparent ending of the subcostal vein. If the nodal region of the wing of any dragonfly be observed under a moderately high-powered microscope, the subcostal vein will be seen to approach the nodus and then make a distinct curve anteriorwards towards the costal margin, at which level it straightens out again and runs along the lower margin of the costal border of the wing as a distinct tubular structure. A reference to the antenodal portion of the costal margin will show that this same tubular structure is absent on the under surface of the wing, and the differences are so striking that it is possible at a glance to tell if you are viewing the antenodal or postnodal part of the costal margin. This formation is only observable on the under surface of the wing because the subcostal vein is a concave one and so, like all such veins, is situated below. In the Protozygoptera, such as *Kennedya mirabilis* Tillyard (fig. 1, *a*), the subcostal vein is seen to run with only the slightest sinuous curve straight on to the costal border after passing the nodal site, for there is no true nodus present in this form; in the Upper Permian form *Permagrion falklandicum* Tillyard, a primitive nodus is present and the course of the subcostal vein is closely similar to that of *Kennedya* although rather more accentuated because the end of the costa itself makes a distinct downward bend to meet the subcosta. Throughout the recent Coenagrions, the formation is identical to that found in the Lower Permian, so slowly has evolution processed: even the more highly advanced forms in the MEGAPODAGRIIDAE (fig. 1, *d*) show but little advance on the COENAGRIIDAE, but the subcosta is perhaps a little more sinuous or even angulated. In all the higher forms of the Zygoptera and throughout the Anisoptera the subcostal vein at the level of the nodus makes a well-marked bayonet-like turn to meet and run on into the costal margin, and its course can then be followed to at least as far as the pterostigma (fig. 1, *e* to *n*). Regarding the costal vein, it appears to terminate at the nodus, for there is a distinct interruption of its course, a deep and narrow fissure separating the proximal and distal portions, whilst the end itself turns downwards and posteriorwards to fuse with the elbow of the subcosta. From the junction of the two veins and at

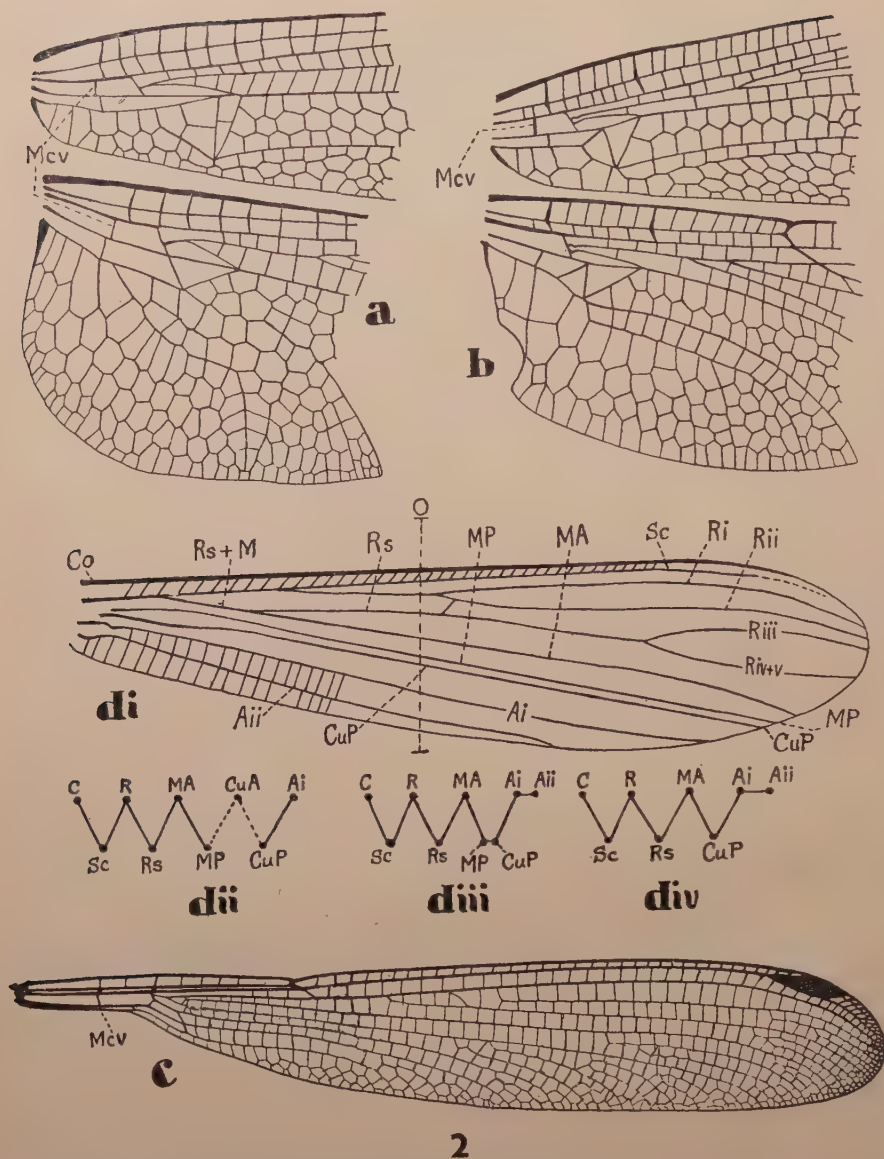


FIG. 2.—a, Base of wings of *Trithemis donaldsoni basitincta* Ris, showing the presence of a median cross-vein in the basal space. From a specimen in the Fraser collection, the first recorded incidence of this vein in the family LIBELLULIDAE; b, base of wings of *Neurogomphus fuscifrons* Karsch, also exhibiting a median cross-vein but in the forewings only; from a specimen in the Congo Belge Museum, the first reported incidence of this vein in the family GOMPHIDAE; c, wing of *Amphipteryx agrioides* Selys exhibiting a median cross-vein: from a specimen in the British Museum (Natural History), the first reported incidence of this vein in the Coenagriodea. (Photo by Martin E. Mosely.) di, Fore-wing of *Euthygramma parallelum* Martynov showing correct notation (cross-veins omitted for the sake of clearness) (Permian) (Tillyardian notation); compare with Martynov's interpretation. O, Site of cross-sections shown in the following figures: dii, cross-section of wing showing the venation as it would be before the loss of a pleat; diii, the same after the pleat has been shed, as exhibited in the fossil; div, the same showing how the venation would appear if evolution had been completed.

the elbow of the subcosta, a short robust oblique strut passes posteriorwards and distalwards, passing under the strong radial vein and then *over* the concave Rii, forming membranous attachments to both. This has always been known as the subnodus and it plays an important part in the mechanics of the wing. A study of the curious way in which it is woven into the meshwork of the main veins leads me to think that it acts as a shock-absorber for each downward beat of the wing, dispersing the impact throughout the surrounding parts of the wing. The subnodal strut is in fact a lever, receiving each downward thrust of the wing at its costal end and exerting its leverage on Rii, the fulcrum being situated on Ri (fig. 1, *g, fl*), the latter vein being admirably suited for this purpose as it is the strongest vein in the wing. Needham was the first to point out the curious tracheation of this region, and he was led to think that the subsequent venation was built up on the tracheae: it is more than evident now that the subnodal region was fashioned by the mechanical needs of the wing and that the tracheation followed afterwards. It is probable that the S-bend in the subcosta at the nodal level also serves its purpose, for it will be appreciated that with any upward or downward shifting of the postnodal region of the costal border from impact on the air during flight, the antenodal portion of the subcostal vein will tend to rotate like a crank-shaft: in other words, the postnodal portion of the vein, together with the S-bend, functions like the starting-handle of a motor car, resulting in the force being imparted to the antenodal portion and then distributed through the medium of the antenodal cross-veins to the costa and other posterior portions of the wing. As in the case of the nodus, the formation of the subnodal strut or brace has scarcely altered, if at all, from what pertained in Permian times, and we can only surmise that its functional powers had already become so perfected that they could not be improved upon during the lapse of millions of years! How eloquent a tribute this is to the laws governing evolution and the survival of the fittest! Thus Zalessky's ideas are proved to be illusory: the costa remains a convex vein and the subcosta a concave one: neither changes its character, nor do I think that any other vein of importance would do so without seriously weakening the wing and so endangering the prospects of survival of the race of insects involved. Probably all such cases may be explained on the hypothesis that a vein of one character has been captured by that of another and its individuality swallowed up and lost in that of the stronger.

I take this opportunity to discuss shortly another type of vein whose function and origin, in so far as I know, has never been studied or discussed by any student of odonatology; these are the cross-veins which are found in the median space of the wings of some species, genera or even throughout whole families of Odonata. These veins are of considerable classificatory importance, but we know absolutely nothing of their function, nor why they should occur in the wings of some dragonflies and not in others. They are present in the following:—

Suborder Zygoptera: *Matrona* Selys, *Echo* Selys, *Neurobasis* Selys, HETAERININAE Tillyard and Fraser, *Heliocharis* Selys (but excluding *H. libera* Selys), and the whole of the POLYTHORIDAE Tillyard and Fraser. In addition, I have now to report the

presence of median veins in a single specimen of *Amphipteryx agrioides* Selys, in the British Museum collection, the only record throughout the whole of the superfamily COENAGRIOIDEA.

LIBELLAGIDAE: *Rhinocypha bifasciata* Selys has the vein in 7 per cent. of the wings, but rarely in all the wings of a single specimen.

This is the only instance known in the whole of this large family.

Suborder Anisoptera :—

AESHNIDAE: *Caliaeschna* Selys, *Cephalaeschna* Selys, *Amphiaeschna* Selys, *Periaeschna* Selys, *Indaeschna* Fraser, *Neuraeschna* Hagen, *Heliaeschna* Selys, *Basiaeschna* Selys, *Gynacanthaeschna* Fraser, *Boyeria* McLachlan (present or absent in this genus), *Telephlebia* Selys and *Austrophlebia* Tillyard.

GOMPHIDAE: Only a single instance is on record, that of a male *Neurogomphus fuscifrons* Karsch, in fore-wings only. (= *Karschiogomphus ghesquierei* Schouteden).

CORDULEGASTERIDAE: CHLOROGOMPHINAE Fraser (number of median veins constant in the various species and thus a definite specific character).

CORDULIIDAE: *Synthemis* Selys (number of veins constant in the species as a rule and therefore a specific character), *Idomacromia* Karsch (fore-wings only), *Neocordulia volxemi* Selys (1906, Martin, *Cat. Coll. Selys*, CORDULIIDAE: fig. 72 shows the wings of a female of this species with the left fore-wing's median space traversed by a single vein, but does not comment on it. Median veins are not found in other species of this genus).

LIBELLULIDAE: So far unknown in this large recent family, but I now record a single male of *Trithemis donaldsoni basitincta* Ris in which both wings on the right side are traversed symmetrically by a single median cross-vein. Specimen in my own collection.

Regarding the origin of these veins, it is necessary to consider the missing MP and CuA, but although I confess to having been intrigued by the possibility of some connection with these missing veins, it has to be said that the evidence of incidence in the species and genera is totally adverse to such a theory. The complete absence of the median cross-veins in the Protozygoptera and all present-day forms belonging to the Coenagriodea suggests that they are a modern innovation of the venation. This is still more strengthened when the incidence of the veins in all neotropical forms of Zygoptera is considered, showing first perhaps in *Amphipteryx* and then *Heliocharis* to which root the others of the neotropical fauna have some very close relationship. A somewhat similar relationship exists between the Synthemines and Chlorogomphines: these show close relationships in the larval stages, and in both subfamilies the median cross-veins occur as definite specific characters: the coincidence is too strong to be accidental. The hyphenated Aeshnas have usually been regarded as archaic forms: would it not be more correct to regard them as highly organised recent offshoots of the AESHNIDAE, as I am inclined myself to regard them? Finally, a microscopic examination of these structures reveals no differences existing between them and ordinary cross-veins, which fact is again not suggestive of any connection with the lost veins of the Odonate wing.

SOME OBSERVATIONS ON THE HABITS OF A MALAYAN ANT OF THE GENUS *CAREBARA*

BY G. H. LOWE, M.B., CH.B., D.P.H.

THE species of *Carebara* which occurs in Malaya is probably *Carebara lignata* (Westwood). It is not common, but is widely distributed, at least on the west coast of the peninsula.

The males are attracted to light, and those I have seen have appeared between eight and nine o'clock in the evening. Deolated queens have been seen in the morning, so that it is possible that the marriage flight occurs sometime during the early evening. My own captures are as follows :—

- | | | |
|----------------|------|---|
| <i>Males.</i> | 1932 | Muar, North Johore. (One, attracted to light.) |
| | 1937 | Ipoh, Perak. (Two, attracted to light.) |
| | 1947 | Sungei Patani, Kedah. (Three, attracted to light.) |
| <i>Queens.</i> | 1936 | Sungei Bakap, Province Wellesley. (A dead, dealated female was found on an earth path at about eleven o'clock in the morning. No workers were found on her legs, body, or on the path.) |
| | 1937 | Ipoh, Perak. (Two dealated females running on a garden path at nine o'clock in the morning. No workers were found on these queens.) |

In Africa ants of this genus have been found living in the masonry of the nests of termites. Forel suggested that these ants are cleptobiotic, and that they prey on the termites.

The queen *Carebara* is much larger than the workers. In *C. lignata* the queen is 19 mm. long and the workers only 1.5 mm. long. In some African species there is an even greater disproportion. Several observers have noted that workers are often found holding on to the tarsi of the queens caught during the marriage flight. The workers hold on to the tarsal hairs of the queens by means of their jaws.

The tarsi of the queens, and to some extent of the workers also, are clothed with dense bristle-like hairs, and Arnold has suggested that these hairs are to enable the workers to hold on to the queens. He also suggested that the large size of the mouth parts of the queen, compared with her worker larvae, might make it impossible for her to bring up her first brood unless she were assisted by some mature workers from the old nest.

On 4th April, 1947, I found a dealated queen *Carebara* in an earth cell, under a large stone, in my garden at Sungei Patani, Kedah. Galleries of a large fungus-growing termite were also present under the same stone. The queen was secured, and the earth cell carefully dug up. No workers were present in the cell or in the surrounding earth. There were no eggs, larvae, or pupae present.

This queen was placed in a small plaster nest. After being restless for some hours she proceeded to fill up the entrance to the inner chamber with plaster débris, and appeared to settle down. On 8th April the queen had laid a small packet of eggs. These eggs were pure white and almost spherical in shape. The queen supported herself on her middle and hind pairs of legs, with her abdomen bent forward in the attitude

of *Formica rufa* when alarmed. The packet of eggs was held between this "abdominal shelf" and her comparatively short front legs.

On 22nd April the first larva was seen. The larva was stoutly built and pale yellow in colour. On 29th April the first pupa appeared. The brood packet now consisted of about one hundred individuals—eggs, larvae and semi-pupae.

The larvae have white mouth parts, and are covered with scattered, anchor-shaped hairs. By transmitted light they appear to have large salivary glands. The eggs, larvae, and pupae appear to be slightly sticky, as they often adhered to the abdomen of the queen, either singly or in small packets. The queen was observed to be constantly licking the brood, which may account for their being sticky. She never paid any larva individual attention, and never manipulated any individual egg, larva or pupa with her mandibles. If the heap became disarranged it was gathered together again by means of her front legs, and sweeping movements of her softer mouth parts. The queen also took pains not to place any of her supporting middle or hind legs on the brood. If one of her legs came down on the young it was at once lifted, and put down on a clear space of the nest floor. Perhaps the function of the dense masses of hairs on her tarsi is sensory, to prevent her harming the delicate brood by stepping on them.

On 8th May one pupa had turned pale yellow, and on 11th May, thirty-five days after the first eggs were observed, the first callow worker appeared. By the 16th May sixteen workers were present, and the first out were now a slightly darker yellow, and were running about the plaster nest. They had not yet been observed to venture into the outer chamber. These workers paid great attention to the eggs, larvae and pupae, constantly licking them, and helping to rearrange the pile if it became disturbed. They paid little or no attention to the queen, only occasionally climbing up her legs and over her abdomen. Only once or twice did I see the queen pay individual attention to a worker, and then it was only to tap it with her antennae as if to make sure that it was not an intruder. The queen was never seen to feed a worker, or a worker to feed the queen.

As it has been suggested that *Carebara* preys on termites, I thought it would be interesting to make some experiments on their feeding habits. As the Malayan species had been found in close association with a fungus-growing termite, it might be that the ants fed on the fungus, and not on the termites themselves.

On 16th May a small piece of termite fungus garden, covered with white fungus nodules, was introduced into the inner compartment of the nest containing the *Carebara* queen and her brood. A few white worker termites were also present. I chose white termites as their jaws were soft, and they could not do any harm to the young workers. The queen became interested immediately, and killed the worker termites with her jaws. Both the queen and the darker, more mature workers then began to feed on the dead termites. Although the worker ants climbed all over the piece of fungus garden, they never paid any attention to the fungus nodules.

The queen fed in a peculiar manner. The dead termite was held between her two front tarsi, and was raised off the floor of the nest to her mouth. I have never seen any other species of ant adopt this method of feeding.

On 20th May some of the workers became more venturesome and wandered about in the outer compartment of the nest. Into this outer chamber three white worker termites were introduced. One of them strayed into the inner chamber and was at once attacked and killed by the queen. The other two were found by an exploring worker *Carebara*. This ant attacked them in turn. Each termite was stung several times on the legs, body and head. Within a few seconds of being attacked the termites became incapable of co-ordinated movement and remained stationary, with an occasional quiver of a leg or an antenna. The ant worker returned to the inner chamber and mingled with the other workers on the brood heap. No other workers came out to the paralysed termites immediately, and although two other workers found them within the next half-hour, after apparently aimless wanderings, no effort was made to bring them back into the nest. Five hours later both termites appeared to be dead, and they had not been moved. Twenty-four hours later they were still in the same position.

From the above experiment it would appear that the worker *Carebara* has a powerful sting which enables her to overcome much larger termite workers with ease. Also both the queen and workers will feed on dead termites. The method by which the mother queen, and the large sexed forms, both mature and in the larval stage, are supplied with food in an established colony has still to be demonstrated. Possibly in this experiment the amount of food obtained by the workers from the saliva of the queen, applied to the brood, and possibly also from larval secretions, was still sufficient for the needs of the number of workers present. If the stimulus of hunger had been present the workers might have brought back the dead termites into the inner chamber. I doubt if the minute workers could feed the queen on regurgitated material.

Unfortunately, circumstances now prevented the continuation of these observations, and the queen and some of the workers were preserved for record.

Whilst the above experiment was in progress evidence was obtained to show that a queen *Carebara*, of the same species, was capable of bringing up workers in her natural environment. On 6th May, 1947, whilst digging up a large nest of the same fungus-growing termite, I found an incipient colony of *Carebara*. The queen was in a small oval cell in the upper part of the termite mound, about one inch from the surface. In the cell were eggs, larvae and pupae, and one very pale callow worker *Carebara*. No fully mature workers were discovered. Unfortunately, the queen was injured when the cell was broken open, so that no further observations could be made in this case.

That a Malayan species of *Carebara* can bring up workers without assistance does not prove that the queens of African species are equally competent. However, in view of the above observations, I do not think that one or two workers could be of great assistance in colony founding. It is also unusual for ants to hang on to objects by their jaws, unless they are fighting or dead. It must often happen that when a virgin queen takes flight from the parent nest she carries one or two workers with her. Most of these workers will fall off her smooth body, and only those on her hairy legs would be able to cling on. If such a queen is caught and placed in some killing agent, the minute workers would die very rapidly, and *in extremis* would bite on to the nearest object, in this case the tarsal hairs of the queen.

LARVAE OF THE BRITISH TRICHOPTERA—25

BY N. E. HICKIN, PH.D., F.R.E.S.

Limnophilus rhombicus L. (LIMNOPHILIDAE).

THIS description is taken from larvae collected from a pond in Broadmoor Wood, Rubery, Worcestershire, and compared with larvae collected from numerous ponds and canals in Worcestershire, Warwickshire and the Lake District. For accurate determination of the species many of the larvae were reared through to the adult stage. A feature of all the habitats was still water and an abundance of submerged and marginal vegetation, but Mosely states that *rhombicus* is found sometimes in slow-running rivers.

Case (fig. 1). Consists of cut stems and roots of aquatic plants, vegetable debris, mollusc shells, etc., arranged tangentially to the chamber and cemented together with secretion. Hinder orifice narrowed. Case almost always has thick appearance. Length up to 27 mm., width up to 6.5 mm. *Larva*: Eruciform, cylindrical, head orthocentrous. Pronotum and mesonotum sclerotised, metanotum with sclerotised patches. Length 19–25 mm., width 3.5–4.5 mm. *Head* (fig. 2): Elliptical, broader aborally. Surface covered with small spines directed orally. Yellowish brown with dark chestnut brown to black markings. Central club-shaped dark mark in the clypeus extending transversely at the oral end. A dark band, in the genae, runs adjacent to the clypeus on each side but leaving three light coloured patches which are quite discernible to the naked eye. One median light patch situated in the aboral vertex of the clypeus and a pair situated where the narrow aboral part of the clypeus widens into the broad transverse oral part. These latter light patches are partly contained in the clypeus and partly in the genae. The dark bands running across the genae are darker orally. A transverse row of four dark spots on each side marks a distinction between the two parts of the bands. Aboral region of genae with pattern of dark spots. Eyes distinct in light areas. Antennae small two segmented, distal segment bristle-like, situated approximately half-way between the eyes and the base of the mandibles. Chaetotaxy as in figure. Gular sclerite (fig. 6) with long narrow aboral projection almost dividing the genae. *Labrum* (fig. 3): Deep concavity heavily marked on anterior margin. Except for central region labrum is covered by blunt hairs. *Mandibles* (fig. 4): Broad and blunt with a small bush of hairs on internal margin near the teeth. *Maxilla* (fig. 5): Smaller than maxillary palp, four bristle-like sense organs at the tip with a few blunt bristles at the base on the inside. Palp four-segmented, proximal segment furnished with several stout bristles. *Labium*: Base of single-segmented palps hairy, three sense organs at top of each palp. Lateral margin of labium dark in colour and the internal sclerites of the labium are readily visible. *Thorax* (fig. 7): Pronotum sclerotised with median longitudinal suture. Anterior third dark in colour, as is also a broad band along the posterior margin. Three separate areas containing dark spots, one median and two lateral. Mesonotum sclerotised with longitudinal suture. Pattern of dark spots. Metanotum with sclerotised patches as in figure. Prothoracic legs short and thick. Black marks at division of trochanter at dorsal surface, a series of short spines along ventral edge of femur, tibia and tarsus in all legs being less in number in prothoracic legs. Meso- and metathoracic legs long, practically equal in length. Prosternal horn present. Ross considers that the horn in all larvae of the genus *Limnophilus* is short, not projecting beyond the apices of the prothoracic coxa. *Abdomen*: Cylindrical creamish white, intersegmental grooves shallow. Lateral line present on the third to eighth abdominal segments. Four sclerotised tubercles on each side of segments 3 to 8 just dorsal to the lateral line. Median dorsal and a pair of lateral protuberances on first



FIGS. 1-10.—Larva of *Limnophilus rhombicus* L. (1) Case. (2) Head. (3) Labrum. (4) Mandible. (5) Maxilla and labium. (6) Gular sclerite. (7) Thoracic nota. (8) *a*, Prothoracic leg; *b*, Mesothoracic leg; *c*, Metathoracic leg. (9) Sclerite on ninth abdominal segment. (10) Anal claw.

abdominal segment. Several black bristles on each side of dorsal protuberance. Sclerite on dorsal surface of ninth abdominal segment (fig. 9) transverse, anterior margin irregular, darker in colour but with a number of light oval marks along it. Four long black bristles inserted along posterior margin with shorter hairs grouped as in figure. Anal claw furnished with a large auxiliary claw and five small ones (fig. 10) (Betten, referring to the LIMNOPHILIDAE of New York State, gives "claws with a single hook"). Abdominal gills present, in groups of not more than three. Anterior gills of anterior segments in groups of three, posterior gills in groups of two. Anterior gills of posterior segments in groups of two, posterior gills simple.

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EQUIPMENT USED FOR TRAPPING AND IDENTIFYING ALATE APHIDES.

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In studying the spread of virus diseases in crops of potatoes and sugar beet, we have made extensive use of sticky traps to gain information on the migration of alate aphides. At first, fixed traps were used with the adhesive material applied and renewed in the field, but these had several disadvantages. To remove the aphides from them a visit by an entomologist was essential: even then recovery was probably incomplete and in wet weather was a most irksome process. The purpose of this note is to describe a detachable type of trap which overcomes these difficulties and has proved most successful in practice. The trap cover can be changed in the field in a few moments by anyone and sent to the laboratory for the collection of the aphides. Some additional equipment for removing the grease simply and rapidly is also described.

The trap.

The basis of the trap is a foot length of galvanised iron stove-piping (usually five inches in diameter), painted white, and fixed to a wooden post at any desired height. Around the piping is wrapped a sheet of transparent plastic coated with a layer of grease-banding substance about 1 mm. thick. The plastic "Xylonite," 10/1000th inch gauge, supplied by Messrs. BX Plastics Ltd., Higham Station Avenue, South Chingford, London, E.4, and "Stopmoth" tree-banding grease supplied by Joseph Bentley Ltd., Barrow-on-Humber, Lines, have been found suitable materials. The grease is easily spread on the plastic with a brush, and aphides remain sufficiently well preserved for identification for as long as a fortnight unless the weather is hot and dry. The covers can be changed easily and quickly in the field and carried in special boxes with the greased face inwards (fig. 1). The plastic cover is held in place on the trap by a strip of brass, bent over one end of the trap and fitting into a socket at the other end (fig. 3). A rectangular recess is cut from the cover so that it fits over, and is held by, the socket, thus simplifying the placing in position of the cover.

Removing the insects.

The plastic cover is laid on a ground glass screen illuminated from behind. The insects are lifted off with a knife and transferred to a glass slide, which is then placed in a test tube. A mixture of equal parts of ethyl acetate and glacial acetic acid is added to cover the embedded insects; when heated in a water bath at 80–90° C. the grease dissolves in the mixture and the insects are usually free from grease in about fifteen minutes. The glass slide is then removed, the liquid drawn off, and phenol ("Carbolic Acid Pure Liquid B.P.") added by means of the apparatus shown in fig. 2. This consists of a filter of capillary tubes

fused into a glass tube of $\frac{1}{4}$ inch bore with a two-way tap giving connection with a funnel containing phenol and a reservoir for waste fluid. A filter pump draws off the fluid through the filter, leaving the insects in the test tube; the tap is turned and phenol flows into the test tube, washing off any insects adhering to the capillaries. A further ten to fifteen minutes in phenol in the water bath clears the insects. The cover is easily cleaned by scraping off the waste grease and washing with paraffin.

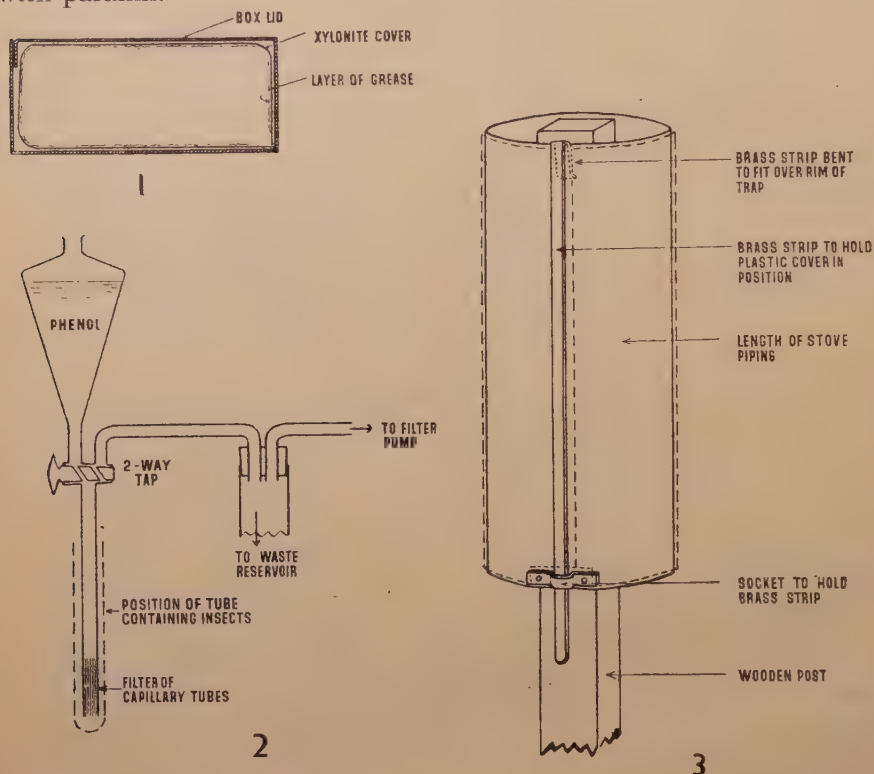


FIG. 1.—Cross-section of cardboard box showing cover folded with grease inside.

FIG. 2.—Apparatus for changing liquids.

FIG. 3.—Diagram of trap. The position of the plastic cover is indicated by broken lines.

Preserving and mounting the insects.

The phenol is an excellent medium for storing or examining the insects or permanent mounts can be made by transferring them direct from the phenol to Berlese's or other gum-chloral mountants. Exposure in insufficient grease sometimes causes the insects to shrivel and become distorted, which makes identification difficult. This can often be remedied by immersion for 6–12 hours in a 10 per cent. solution of potassium hydroxide at room temperature, followed by dehydration in alcohol and clearing in phenol. This treatment also helps to prevent the shrinkage which often takes place when aphides are transferred to Berlese's mountant after storage in phenol.

LARVAE OF THE BRITISH TRICHOPTERA -26

BY N. E. HICKIN, PH.D., F.R.E.S.

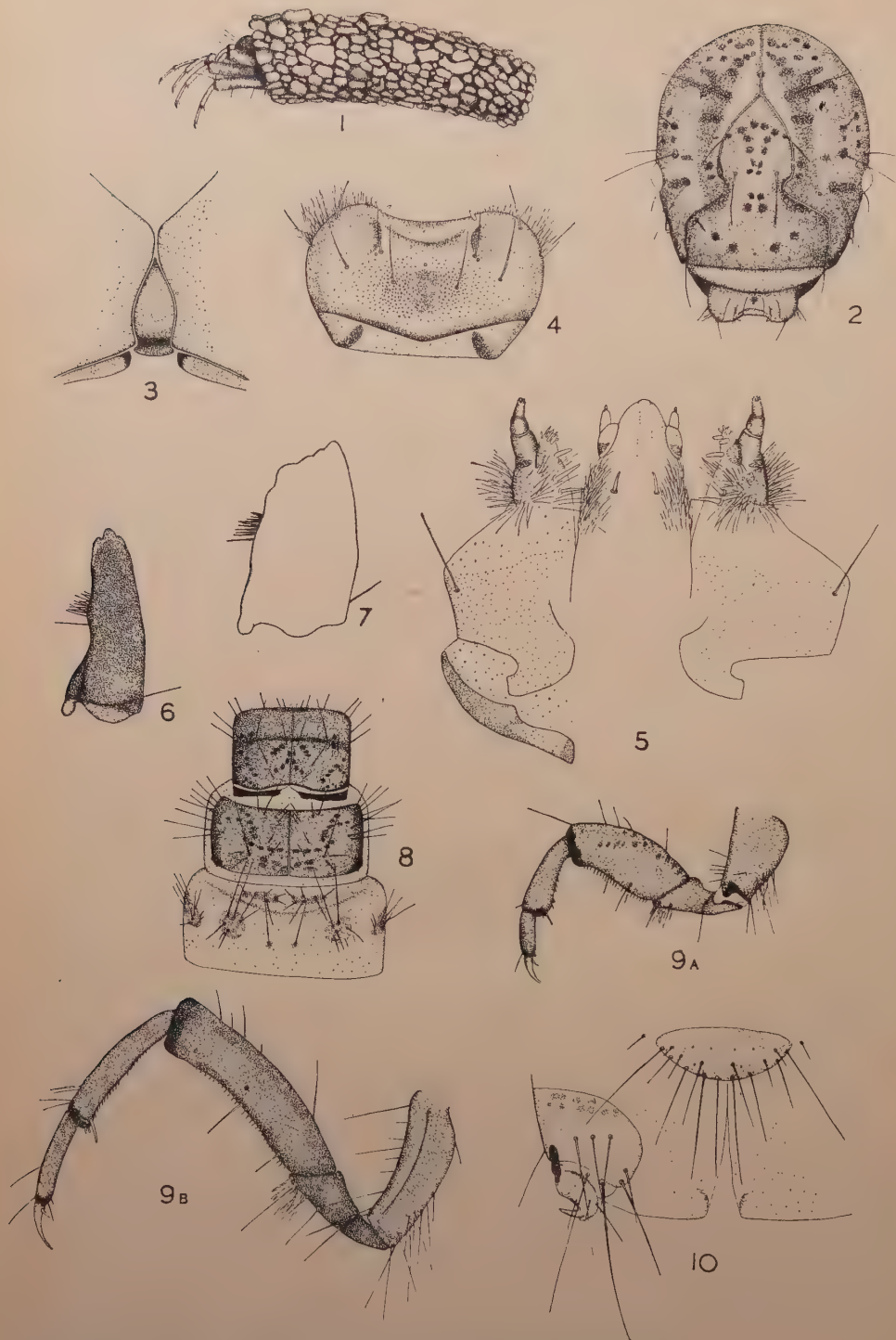
Chaetopteryx villosa (Fabricius) (LIMNOPHILIDAE).

LARVAE of this widely-spread caddis fly were found to be common in 1945 and 1946 in a small stream at Nutfield, Surrey. This stream flows with moderate speed, and is characterised by having thick marginal and overhanging vegetation. The larvae were more abundant where the stream was less turbulent, and where the stream bottom alternated with large flat stones and patches of mud. The depth of water was about eight inches, and larvae of *Halesus digitatus* (Schränk) were found commonly in the same habitat. Larvae of *Plectrocnemia conspersa* (Curtis) were also very common and constructed their nets in the more turbulent portions of the stream where it rippled over the stones.

Two of the *C. villosa* were reared to the pupal stage, and by dissecting away the pupal integument the underlying imaginal genitalia were made out.

This species was reared also in 1937 from larvae collected from a small stream—scarcely more than a trickle—in Broadmoor Wood, Rubery, Worcestershire, and also from larvae collected from a small stream in Painswick, Gloucestershire, in 1937.

Case (fig. 1). Of large sand grains and small chips of stone, slightly arched, up to 20 mm. long and up to 4 mm. wide. It should be noted, however, that adults of this species show a wide variation in size; such a disparity should be seen in the full-fed larvae. No satisfactory explanation has so far been put forward to account for this phenomenon. Other materials for casemaking are said, on occasion, to be used—vegetable débris, cut roots, leaves and snail shells, longitudinally or obliquely placed. *Larva*: Eruciform, up to 15 mm. long and up to 3 mm. wide. *Head* (fig. 2): Orthognathous, dark golden brown with darker brown markings, eyes situated laterally, antennae small. Concavity between oral and aboral parts of the clypeus fairly deep. Clypeus mark triangular consisting of about twelve dark brown marks. In the region of the concavities a group of four dark marks is situated in two pairs and in the oral region a further four dark marks extend transversely. In the genae a wide dark band extends on either side of the clypeus, joining dorsally by the mid-genal suture. A number of darker marks is contained within the bands. *Chaetotaxy* as in the figure. *Labrum* (fig. 4): Golden brown with greyish brown shallow excised anterior margin. Posterior margin black, posterior incurved angles black. Apart from the darker margins, labrum has four areas darker in colour, a large central area made up of a number of small dark spots, a transverse concave ridge situated just posterior to the anterior margin and a pair of bulbous prominences directed inwardly. *Chaetotaxy* well defined as shown in fig. 4. *Mandibles* (figs. 6 and 7): Long, black, each with three teeth, narrow, when seen from above, and with five teeth, one very small, and broad when seen from the inner face. A group of small bristles, with an isolated longer bristle situated on a convexity on the inner edge of each mandible. A long outwardly-directed bristle at the base of each mandible. *Lestage in Rousseau* states that there are two short bristles on the "dorsal side". I never found two bristles. (There does appear to be a tendency for the bristles to break off, however, in some species.) *Maxillae* (fig. 5): Maxillary palp of four segments, the sclerotisation of the proximal segment not completely encircling it. The



FIGS. 1-10.—Larva of *Chaetopteryx villosa* Fabricius. (1) Lateral view in case. (2) Head. (3) Gular sclerite. (4) Labrum. (5) Maxillae and labium. (6) Right mandible from above. (7) Right mandible from the inside. (8) Thoracic nota. (9) *a*, Prothoracic leg ; *b*, Mesothoracic leg. (10) Anal segments of abdomen.

maxilla has a large golden brown sclerotised plate on the outer side with two large inwardly directed spines on the inner side. The mala also has a golden brown sclerotised plate on the outer side with a single large blunt bristle on the inner side. It is furnished at the tip with several sensory organs, some of which are large. *Labium* (fig. 5) : Labial palp two-segmented with large terminal rod-like sense organ. Proximal segment large and bulbous with golden brown sclerotised patch at the base. The spinneret is barely perceptible at the tip of the ligula. *Gular sclerite* (fig. 3) : Not completely dividing the genae. Small concavities in the lateral margins at the anterior end fit in the anterior ventral apices of genae. (Note : In the figure the anterior part is shown lowermost in order to correspond with the figure of the head, which is best observed under the low power of the microscope in this position.) *Thorax* (fig. 8) : Pro- and mesonota sclerotised, metanotum with sclerotised patches. Pleural margins of pronotum parallel, posterior margin very heavily sclerotised with double black bands, the outer (considerably larger) divided, the inner divided only by the median longitudinal suture. A transverse narrow dark band is situated one-third of the length of the pronotum from the anterior margin. Mesonotum wider than pronotum with median longitudinal suture. Posterior lateral apices of mesonotum black. Metathoracic segment wider than mesothorax. Anterior pair of sclerites transverse, each bearing six bristles. An integumentary fold in the metanotal membrane divides these latter sclerites from the remainder, which consist of a pair of oblique pleural sclerites, a pair of circular sclerites on the notum, each containing about six bristles of unequal length. Between these latter sclerites is situated a pair of bristles with a small golden brown area at the base. *Legs* (figs. 9a and b) : Prothoracic legs short. Anterior extremities of femur, tibia and tarsus black. Meso and metathoracic legs long, approximately equal in length. Anterior extremities of femur, tibia and tarsus dark in colour. Trochanter in all legs divided into two segments, the proximal segment of which is devoid of hairs and bristles. *Abdomen* : Cylindrical, creamy white, protuberances on first abdominal segment small. Lateral line present from third to eighth segment and made up of black hairs. A series of small sclerotised protuberances or "points" associated with the lateral line is definitely present although very indistinct. There appear to be four (on each side) in the anterior part of the third segment (just dorsal to the lateral line), three in the fourth segment and two in the fifth segment. Single filiform gills present on second to seventh segments inclusive. On the seventh segment ventral gills are present only. The sclerite on the dorsal surface of the ninth segment (fig. 10) is greyish brown in colour with many unequal hairs. Anal claw (fig. 10) with auxiliary hook and large basal segment sclerotised and furnished with several long bristles.

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NOTES ON THE OVIPOSITION SITE AND METHOD OF REPRODUCTION OF THE WEEVIL *STROPHOSOMUS MELANOGRAMMUS* (FORSTER) (COL.).

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PRELIMINARY investigations into the biology of the weevil *Strophosomus melanogrammus* Förster (*coryli* Fabricius) have revealed some interesting points with regard to the oviposition site and method of reproduction.

The species is common in Britain and may be found on a number of hosts although most commonly on oak, hazel and pine. It is considered an important pest of pine culture in Germany, but rarely assumes pest proportions in this country.

Previous authors are agreed in stating that *S. melanogrammus* oviposits in or on the ground.

Kleine (1911), quoting Bohutinsky, who claimed to have bred the weevil, stated that "after copulation, a part of the weevils, probably the females, went into the earth." Oviposition, according to this author, began in mid-June, the eggs being laid in small heaps of 3-5, but sometimes singly, deep in the soil.

Reissig (1928) records that oviposition occurs preferably on the grass *Aira flexuosa* or on dry *Hylocomium* moss, and that the larvae feed on the roots of these plants.

Escherich (1923) and Sorauer (1913) state simply that eggs are laid in the ground in spring and that the larvae feed on the roots of weeds and grasses.

In the present work weevils were kept in hurricane lamp-glass cages, over flower-pots containing fine sterilised soil and young pine shoots were provided as food material. Eggs were not laid in the soil as was expected, but in various protected situations on the pine shoot. Thus clusters of eggs were found between the bases of the two needles on a short shoot, where they are closely approximated and surrounded by scale leaves; between the scale leaves and needles, and mostly below the scales of the terminal bud.

Control experiments in which small numbers of grass and lettuce seeds were germinated in the soil gave the same result, all eggs being laid in sites on the pine shoots. A further experiment was carried out in which the shoots were replaced by oak shoots bearing buds which were in the process of opening, and a piece of turf was substituted for the soil in the pots. Here also all eggs were laid in clusters below the bud scales.

In other experiments connected with this work, individual weevils were confined in small tubes closed by bored corks covered with muslin. A recently opened oak bud was provided as food material.

In these experiments it was noticed that any site which would afford reasonable protection to the eggs, which have a soft chorion and are

easily damaged, was likely to be used for oviposition. Thus eggs were laid not only below the scales of the oak bud, but also between two leaves when closely appressed; between a leaf and the side of the tube, in cracks in the cork, and on the cork below the muslin. The eggs are held together and to the substratum by a form of cement. The sizes of the egg groups seem to depend largely on the size and suitability of the site, small cracks in the cork containing a small number of eggs, the larger bud scales having 20 or more below them.

The nature of these oviposition sites and the thin and flexible nature of the chorion led to the supposition that eggs would be laid in similar situations in the field—*i.e.*, below bud-scales, between pine needles or in cracks in bark.

Careful search of smaller oak trees on which *S. melanogrammus* was abundant led to the discovery of eggs below bud-scales, but not in any other situations. The author was not successful in finding eggs on pine.

It would seem therefore that *Strophosomus melanogrammus* does not lay in the ground, and that this view may have arisen from the discovery of newly emerged larvae on the surface of the soil. These larvae have hatched from eggs laid on the host plant and have subsequently fallen to the ground.

Reitter states in his *Fauna Germanica* that only females of *Strophosomus melanogrammus* are found and that males seem to be lacking. Fowler in his work on British Coleoptera indicated that in males of the genus *Strophosomus* the tibiae are terminated by a small hook, but does not state specifically whether or not they occur in the species *melanogrammus*.

Ullman (1920) examined groups of *Strophosomus melanogrammus* from various parts of Norway and Denmark, and identified males in each group. The male, he states, is smaller and more elliptical than the female, and in common with the unfertilised female lacks the black longitudinal patch at the base of the elytra near the scutellum. Ullman claims that this black patch which is bare of scales is the result of copulation, and is not found in females which have not copulated. Unfertilised females of *Strophosomus melanogrammus* can, according to this author, only be distinguished from females of the allied species, *S. rufipes* Stephens on the shape of the bristles on the elytra.

Munster (1921) re-examined the material described by Ullman and concluded that this author had been mistaken in his identification. The specimens which Ullman had stated were males and unfertilised females of *Strophosomus melanogrammus* were no more than *S. rufipes*, and one specimen was actually *Sciaphilus asperatus* Bonsd.

In a later paper (1922) Ullman describes a number of males which had been found in copulation with females of *Strophosomus melanogrammus* and which, on the character of their bristles, he had determined as belonging to the same species. Dissection of these specimens by another worker and comparison with males of *S. rufipes* revealed "small but nevertheless observable differences in the form of the pairing organ."

All specimens (327) collected on Putney Heath (London) in the autumn of 1946 were females and all possessed the characteristic black

line at the base of the suture of the elytra. Dissection of over a hundred of these females revealed in every case an empty spermatheca, and it was therefore concluded that *Strophosomus melanogrammus* hibernates unfertilised. Seventy-five of these weevils were kept in cultures out of doors through the winter. Of these, twenty-eight survived to lay eggs, from 90 per cent. of which larvae hatched out.

When emergence from hibernation began in the spring, collecting was resumed on Putney Heath and 44 weevils obtained, but again no males were found. After the end of April the work was continued near Ascot (Berks), and here copulating pairs of weevils of which the females were *Strophosomus melanogrammus* were found on two occasions. One female was dissected immediately, and found to be unfertilised; the other was first allowed to lay eggs and then dissected, but in this specimen also the spermatheca was empty. Attempts to rear the larvae which hatched from the eggs of the latter female were unsuccessful.

Dissection between April and July of about 250 females, collected both at Putney Heath and near Ascot, revealed only one which was fertilised.

The males of the pairs noted above differed from the *Strophosomus melanogrammus* females in that they were much smaller, their elytra were narrower at the base, and without the characteristic shoulders and black line at the base of the suture. They could not be distinguished from males of *S. rufipes* even on the basis of the bristles on the elytra or on the genitalia.

It is therefore considered possible that under certain circumstances males of *S. rufipes* may copulate with females of *S. melanogrammus*. Under highly artificial conditions of confinement within small (3×1 inch) tubes this was accomplished, but in no case did fertilisation occur. It is unlikely that conditions bringing the males and females of the allied species into such close contact would obtain in the field. The experiments, however, serve to show that copulation (but not necessarily intromission) between *S. rufipes* males and *S. melanogrammus* females is not impossible, and that the possibility of the males found copulating with *S. melanogrammus* females in the field being those of *S. rufipes* cannot be completely excluded.

The single occurrence of a fertilised *S. melanogrammus* female may thus be due to (1) the definite existence of males in this species or (2) a chance copulation (with intromission) between a *rufipes* male and a *melanogrammus* female. In the light of the evidence available, both explanations would appear equally probable.

It would seem, therefore, that in the areas investigated the normal method of reproduction in *Strophosomus melanogrammus* is parthenogenetic, but that the possibility of the existence of males must be considered.

Reference to other records of parthenogenesis in the CURCULIONIDAE (Spessivtseff 1923, Jahn 1941) would suggest also that it is of the thelytokous type—unfertilised eggs giving rise to females only, fertilised eggs to both sexes. That such is also the case in Northern Europe at least is suggested by the contradictory nature of the literature in reference to the occurrence of males.

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Series A and B are issued in twelve parts, forming an annual volume of approximately 240 pages each.

The following information is supplied for the guidance of authors wishing to submit papers for publication in any of the Society's journals.

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A uniform method is adopted for the citation of bibliographical references in the Society's publications as follows :

Smith, A., 1936, New species of COCCIDAE. *Proc. R. ent. Soc. Lond.* (B) 6 : 301-306, pl. 1.

—, 1936, New species of COCCIDAE. *Trans. R. ent. Soc. Lond.* 84 : 901-936.

Titles of periodicals cited are to be abbreviated in the manner indicated in the *World List of Scientific Periodicals*, 2nd edition, 1934.

Authors are entitled to receive 25 copies of their papers free of charge and may purchase additional copies provided that request be made before publication.

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MEETINGS
TO BE HELD IN THE SOCIETY'S ROOMS
41, Queen's Gate, S.W.7

1948

WEDNESDAY, July 7

,, September 1
,, October 6
,, November 3
,, December 1

**THE ROYAL ENTOMOLOGICAL
SOCIETY OF LONDON**

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